The Glass Industry
REG. U. S. PAT. OFF.

Vol. 10 MARCH, 1929 No. 3

Thirty-first Annual Meeting of the American Ceramic Society

Greatest Gathering in the Society's History Held at Chicago

All records for attendance were broken at the Thirty-first Annual Meeting of the American Ceramic Society, held at the Stevens Hotel, Chicago, from February 4 to 9 inclusive. The following organizations met at the same time:

American Face Brick Association (Divisional)
American Refractories Institute
Common Brick Manufacturers Association
Canadian National Clay Products Association
Grinding Wheel Manufacturers Association
Illinois Clay Products Association
National Brick Manufacturers Association
Structural Tile Association

Election of Officers

The election of officers for the American Ceramic Society during the ensuing year resulted as follows:

President: G. A. Bole, Secretary, Ohio Ceramic Industries, Columbus, O.
Vice-President: Fred A. Harvey, Harbison-Walker Refractories Company, Pittsburgh, Pa.
Treasurer: H. B. Henderson, Standard Pyrometer Cône Company, Columbus, O.

Glass Division Officers for Year 1929-1930

Chairman: J. T. Littleton, Corning Glass Works, Corning, N. Y.
Vice-Chairman: E. W. Washburn, Washington, D. C.
Secretary: George W. Morey, Geophysical Laboratory, Washington, D. C.

The joint sessions of the Society were held in the ball room of the Hotel Stevens, on Monday, February 4, beginning at 10 A.M. with an address by M. C. Booze, President of the American Ceramic Society. Of special interest to glassmakers was an address by F. C. Flint, Chief Chemist, Hazel-Atlas Glass Company, entitled: "The Functions of the Glass Technologist." The speaker outlined the ways and means by which the glass technologist can be of service to the organization of which he is a part. He pointed out that the glass technologist simply makes use of the tools given him by modern science, for the solution of problems of the glass-house. An address of this nature helps to fix in the mind of glass manufacturers what can be expected from a trained technologist and what encouragement must be awarded to him so that he may best serve his industry.

A noteworthy feature of the meeting was the Ceramic Exhibition which attracted thousands of visitors. Among the exhibiting firms were the following:

Cambridge Glass Company, Cambridge, Ohio.
Carr-Lowrey Glass Company, Baltimore, Md.
Fostoria Glass Company, Moundsville, W. Va.
Hazel-Atlas Glass Company, Wheeling, W. Va.
Vitrolite Co., Chicago, Ill.
The Bristol Company, Waterbury, Conn.
The Brown Instrument Co., Philadelphia, Pa.
The Buckeye Clay Pot Co., Toledo, O.
Ceramic Color & Chemical Mfg. Co., New Brighton, Pa.
Consolidated Feldspar Corp., Trenton, N. J.
Corhart Refractories Co., Louisville, Ky.
The DeVilbiss Company, Toledo, O.
Dings Magnetic Separator Co., Milwaukee, Wisc.
Erwin Feldspar Co., Inc., Trenton, N. J.
General Color Products Co., Chicago, Ill.
Golding Sons Company, Trenton, N. J.
Hardinge Co., York, Pa.
Illinois Testing Laboratories, Chicago, Ill.
Johns-Manville Corporation, New York, N. Y.
Leeds & Northrup Co., Philadelphia, Pa.
Link-Belt Co., Chicago, Ill.
The Manufacturers Equipment Co., Dayton, O.
Newark Wire Cloth Co., Newark, N. J.
The Texas Co., Chicago, Ill.
Wilson-Mauelen Co. Inc., New York, N. Y.

Plans are already under way to repeat the exposition, which was the first ever attempted in the United States. More than 62,400 persons passed through the doors of the show which, in itself, is felt to be of much value to the industry.

Besides that an intensive newspaper publicity campaign was carried on for two months, something like 1,200 newspapers carrying advance stories. The radio campaign consisted of sixteen days of broadcasting from four stations.

Chicago department stores, public utilities and banks cooperated by making displays of American-made ceramics.

The next annual meeting of the Society will be held at Toronto, Ontario, early in coming year.

Glass Division Meetings

The meetings of the Glass Division opened on Tuesday, February 5, C. D. Spencer, in the chair.

Before proceeding with the papers, F. C. Flint spoke a few words in appreciation of the services rendered to the Glass Division by the late A. R. Payne. The Secretary was instructed to convey to Mrs. Payne the expression of sorrow of the members of the Glass Division caused by the death of her husband, which occurred on December 26, 1928.

FRED A. HARVEY,
Vice-President,
American Ceramic Society

The following papers were read:

The European Glass Tour in 1928

By Alexander Silverman, University of Pittsburgh

The speaker gave a brief account of the principal places of interest visited by the members of the Glass Division who took part in the trip.

In France the plant of A. La Croix, manufacturers of ceramic color was visited. This factory is engaged in the manufacture of purple of Cassius and other chemicals used in the making of colored glass. Dr. Silverman gave an illustrated lecture on "Recent Developments in American Glass Manufacture" at the Maison, Centreau, on invitation of the Associated Ceramic and Glass Sections of France. The lecture was delivered in French before a group of five hundred members and delegates of these societies.

A visit to the great Plate Glass Works of Chantereine was one of the outstanding features of the visit to France. This modern equipped, gigantic plant, located near Compiegne, proved to be of great interest.[1]

The party then proceeded to Nancy where the Crystallerie de Nancy, manufacturers of tableware and art glass in a variety of colors, was visited. The show room of Daum Freres whose reputation for artistic production is unrivaled proved to be worthy of its fame. The work equals that of Lalique and in some respects surpasses it.

In Strassbourg the Crystallerie de Saint Louis was visited. The party then proceeded to Munich where the most interesting feature proved to be the "Deutsche Museum." This museum contains exhibits giving the visitor a picture of the developments of the arts and sciences throughout history with a detail unsurpassed by any other institution of this kind. It excels even the oldest museum of this nature, the Conservatory of Arts and Crafts of Paris.

In Carlsbad, Czechoslovakia, the firm of Moser was visited, noted for its Alexandrite glass which has a beautiful amethyst color caused by neodymium. This color shades from pale violet to deep heliotrope according to the light falling upon it.

In Berlin the laboratory of the Silicate Institute was visited. Under the leadership of Dr. K. Endell, this institution is doing fundamental research on silicates. The Osram Works[2] were then visited where the party was shown around the works by Dr. G. Gehlhoff. This concern has carried technical control of manufacturing to a greater length than any factory in Europe. Raw materials cannot be introduced into the storage bins until they have been tested in the chemical laboratories. The chief chemist is the only individual who has any key to unlock the bins. The furnaces are under strict pyrometic control and are being checked up by optical pyrometers.

The Bicheroux Plate Glass works at Herzogenrath[3] was visited, after which the party proceeded to England by way of Holland. They were received by Dr. W. E. S. Turner, Professor of Glass Technology at Sheffield University who with his co-workers is carrying on more fundamental research work on glass than is being done in any other single laboratory in the world.

Dr. Silverman then described glassware found in the Vatican Museum in Rome, the Salviati Museum of Venice and his visit to Murano. Also, his visits to the glass works of Val Saint Lambert in Belgium and the great glass works of Schott und Genossen in Jena, Germany.

Viscosity Measurements in Glass

By Howard R. Lillie, Corning Glass Works.

In a recent paper read before the Glass Division of the American Ceramic Society, which will appear in detail in an early number of the Journal of that Society, a method was described for the measurement of viscosities in glasses at temperatures between 700 and 1400°C.

This method consists of rotating a cylindrical crucible, containing about 1 kg. of glass, and observing the torque exerted upon a spindle, suspended into the center of the glass by means of a torsion member. No calibrations were made with standard fluids, but all results were computed from the derived equation applicable to the case, to which was applied a correction, determined empirically, for the finite boundaries of the system. This correction was determined by measuring the apparent viscosity of castor oil by means of spindles of various lengths and several different radii. By plotting apparent viscosity against the reciprocals of the lengths of several spindles of equal radii, a value of true viscosity can be read from the $\frac{1}{L} = 0$ intercept. An average of the extrapolated values from a great many such curves gave a value of 9.67 poises for the viscosity of the oil at hand at 20°C. Using this as the true viscosity, the effective length of any spindle may be computed and the additional length found to which the presence of the ends of the spindle is equivalent. For the spindles used in glass viscosity measurements (.95 x 10.2 cm.) a correction of 0.44 cm. was found.

In the measurements of glass viscosity, extreme care was exercised in the regulation and measurement of temperature. For the most part a molybdenum furnace was used. Platinum heating units were placed above and below the crucible to counteract the end heat losses. Temperature uniformity was indicated by three couples, one under the crucible, one inside the spindle and one directly over the crucible cover, while actual temperature readings were made from the thermocouple inside the spindle.

Results were found to agree at high viscosities with a derived value of viscosity at the "softening point" of the glass. At lower viscosities it was found that, within reasonable limits, the results were in agreement with those obtained using the velocity of a falling sphere.

Comparisons were made between results obtained by various other workers in this field and those obtained in this investigation. Viscosities for the exact compositions cited by others were found by a method of interpolation between neighboring glasses of almost the same composition.

A good agreement was found in this investigation with the work published by S. English, the two methods being similar except that English measured the angular velocity of the spindle turned by a falling weight while the crucible remained stationary. His viscosities were computed on the basis of an empirical calibration factor obtained with standard liquids.

An equally good agreement with the results of V. Stott was obtained by the same method of interpolation. Stott used a falling sphere method and also another method in which he pulled a wire slowly out of the glass and used the amount of adhering glass as a measure of viscosity. Both of these methods gave results in close agreement with those of this investigation.

The results of this investigation did not agree so well with the results obtained by E. Washburn. The difference is ascribed to the fact that Washburn used a variable calibration factor while

[1] THE GLASS INDUSTRY, April, 1928, pp. 75-78.
[2] THE GLASS INDUSTRY, January, 1928, pp. 7-9.
[3] THE GLASS INDUSTRY, September, 1927, pp. 207-208. October, 1927, pp. 231-238.

in the work reported here as well as in the work of English a constant factor is used.

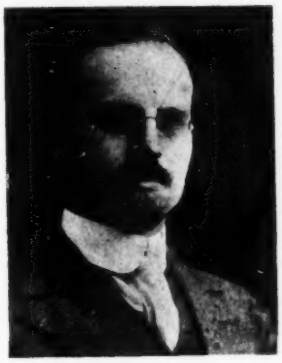
The Bicheroux Plate Glass Process

By J. Earl Frazier, Simplex Engineering Co., Washington, Pa.

The lecturer gave a description of the new process of plate glass manufacture developed in Germany which is now being introduced in this country. It was illustrated with numerous lantern slides showing the casting of the molten glass between two rollers. The plates are then received on a moving platform and cut to appropriate lengths. They are then removed at once to the lehrs.

Officers of the Glass Division

I. T. LITTLETON,
Chairman



E. W. WASHBURN,
Vice-Chairman

GEORGE W. MOREY,
Secretary

Other papers presented during the Tuesday Session were:

Glass House Refractories, C. E. Fulton, Pittsburgh Plate Glass Co., Pittsburgh, Pa.

Radiation Method of Measuring Strain in Glass, L. R. Ingersoll, University of Wisconsin, Madison, Wisc.

Dissolved Gases in Glass and Their Effects on Physical Properties. A Preliminary Report. R. C. Darnell, Bureau of Standards, Washington, D. C.

Dimensional Changes in Glass Caused by Heating Cycles, A. Q. Tool, D. B., Bureau of Standards, Washington, D. C.

At the sessions of the Glass Division on Wednesday, February 6, the following were among the papers presented:

Volatility of Selenium and Its Compounds in the Manufacture of Selenium Ruby

By J. B. Krak, The Roessler & Hasslacher Chemical Co., Perth Amboy, N. J.

This paper reported the results of experimental work done in the Glass Experimental Station of The Roessler & Hasslacher Chemical Company, showing that in the manufacture of selenium ruby glass about three-fourths of the selenium added is lost by volatilization. The claims that selenium when added as sodium selenite or barium selenite is less volatile than metallic selenium are not substantiated. Therefore the high prices of these materials make their use prohibitive.

Some Recent Developments in Methods for the Analysis of Glass

By G. E. F. Lundell, Bureau of Standards, Washington, D. C.

A. The Use of 8-Hydroxyquinoline in Analysis of Ceramic Products.

An interesting development in the method for the analysis for ceramic materials during the last two years has been the recommendation of the use of 8-Hydroxyquinoline for the determination of elements such as aluminum, zinc and magnesium. This reagent has been studied at the Bureau of Standards. In acetic acid solutions it reacts with zinc, aluminum, titanium, zirconium, lead, antimony, manganese and iron, while in ammoniacal solutions it reacts with beryllium, calcium, barium and magnesium as well.

8-hydroxyquinoline precipitates magnesium quantitatively in ammoniacal solution, even in the presence of oxalate, and so furnishes a means of separating it from the alkalies without introducing a non-volatile reagent. If a sample of glass is dissolved without the use of alkali salts, as for example by attack with hydrofluoric and sulphuric acids, the analysis can follow along usual lines until the calcium is out, the magesium can then be precipitated by 8-hydroxyquinoline and the alkalies obtained as sulphates by evaporating the filtrate to dryness and igniting gently.

8-hydroxyquinoline precipitates so many elements in ammoniacal solution that in certain cases the determination of the alkalies can be made much more rapidly through its use than by the use of the older methods such as the J. L. Smith or the Berzelius. Necessary conditions are (1) a material that can be broken up by acid attack and (2) no elements other than alkalies that are not precipitated by 8-hydroxyquinoline. If the first condition can be met, the only element that causes difficulties in the usual case is calcium, which remains in part with the alkalies and necessitates a correction based on a determination of it in the weighed alkali sulphates.

In analyses of material containing aluminum, preliminary separations, such as filtration after precipitation with sodium hydroxide or extraction of alkali carbonate or hydroxide melts with water, often leaves aluminum still associated with elements such as fluorine, boron, phosphorus, arsenic, vanadium, molybdenum, uranium, columbium, tantalum, and beryllium. In such cases, precipitations with 8-hydroxyquinoline serve to separate aluminum quantitatively from fluorine, boron, phosphorus and arsenic if made in ammoniacal solutions, from vanadium, tantalum, columbium, titanium, and molybdenum if made in ammoniacal solutions containing hydrogen peroxide, from uranium if made in solutions containing ammonium carbonate and from beryllium if made in acetic acid solution. B. A. Reagent for Sodium.

A specific reagent which has been recommended for the rapid gravimetric determination of sodium is uranyl zinc acetate. The precipitate which it produces with sodium ion has the composition expressed by the formula $(UO_2)_3$ Zn Na $(CH_3\ COO)_9 6H_2$ and contains only 1.495 per cent of sodium. The precipitation is carried out at room temperature in as concentrated a solution as possible and the precipitate is washed with 95 per cent alcohol saturated with the precipitate, then with ether, dried by sucking air through and weighed. Small amounts of potassium do not interfere, neither do ammonium salts, barium, calcium, magnesium or zinc. Lithium strontium phosphates and organic acids interfere.

The speaker then described in considerable detail the methods for the determination of silica and fluorine in opal glass.

Density Factors for Soda-Lime Glasses

By S. R. Schales, Federal Glass Company.

The density factors calculated for the glass-forming oxides by Winkelmann and Schott and other investigators do not yield accurate predictions of density values when applied to many glasses. This paper describes an attempt to develop a set of factors for the compounds in the glass, assumed to be $Na_2O.2\,SiO_2$, $CaO.SiO_2$, $MgO.SiO_2$, SiO_2, and Al_2O_3. These factors, applied to a series of six commercial glasses, give results accurate within one-half of

one per cent of the measured values for density. The glasses ranged in composition between 72 and 76% SiO_2, 14 and 18% Na_2O, and 7 and 11% CaO+MgO, with varying ratios between CaO and MgO. Comparisons are made with calculated densities using oxide-factors from four sources, showing less consistent results with the latter. Application of this method of compound-factors to a wider range of compositions must be made before it can be demonstrated to have general value.

The factors proposed are:

$Na_2O.2SiO_2$....2.48
$CaO.SiO_2$.....2.99
$MgO.SiO_2$.....2.72
SiO_2.....2.24 (Baillie)
Al_2O_3.....2.75 (Tillotson and Others)

A Study of the Relation Between the Chemical Composition and Some Physical Properties of Certain Glasses

By L. D. Fetterolf, Dept. of Ceramic Engineering, University of Illinois

Among the physical properties of glass which in nearly every case partially determine its utility are thermal expansion and elasticity and they are often factors of first importance.

Owing to the relatively low thermal conductivity of glass all parts of a glass object cannot even approximate equal temperature when subjected to temperature change. Such differences in temperature result in internal stress.

The study mde was on the oxides BaO, ZnO, Na_2O, and SiO_2. Both BaO and ZnO have been used to a considerable extent in glass. Acting similarly to PbO, they have in a measure taken the place of that oxide.

A suvey of the literature has revealed the fact that little work has been done on the effects of BaO and ZnO on elasticity. The work done on their thermal expansion has for the most part been confined to expansion below 100°C.

This investigation was for the determination of the effects of BaO and ZnO on elasticity and a comparison of the two in this respect. If possible, it was desired to assign a factor to each and to compare such factors with those which have been assigned to other oxides.

The method made use of an accurately dimensioned glass bar used as a cantilever beam, rigidly fixed at one end and free to deflect at the other upon application of a load. The end of the glass bar was securely fixed in a heavy iron block about 5 inches square and 8 inches in height.

A 500 gram load in every test was applied to the free end of the bar. All bars but two were of such length that the load could be applied at a distance of 20 cm. from the block making the effective length of the bar 20 cm. This distance was measured as accurately as was possible with a rule marked in tenths of a centimeter. In order to apply the load at the 20 cm. mark a loop of thin wire was passed over the beam at the desired place. A weight attached to the free end of the wire made the effective load 500 grams.

The microscope being focussed on the beam at the point where load was to be applied, the bar was deflected several times by pressure from a finger. This was necessary in order to detect any "slack" in the fixed end of the beam. After several repetitions of this treatment followed by tightening of the cap-screws the beam returned to its original position after the application of load and could be deflected for an actual measurement.

For the expansion an interferometer was used. The small size of the specimen employed simplified the problems of uniform heating, temperature control and uniformity of specimens. The interferometer itself is quite sensitive to temperature change.

The method used for chemical analysis were those outlined by the Glass Division Committee on Standards, American Ceramic Society.

In the preparation of the glass silica was held constant throughout at 60%. ZnO varied from 6 to 30% in 6% intervals, the same values and variations were selected for BaO. Soda made up the remainder of the batch. Five glasses were made up for each series.

Annealing was done in an automatically controlled electrical furnace. The annealing temperature was determined by the deformation of a glass rod 1 mm. in diameter, placed on the edge of a small porcelain tile. The rod projected one inch on either side of the tile which was placed so that it was in the middle of a steel plate. The temperature was raised at the normal heating rate of the furnace. The time varied from 30 to 50 minutes depending on the glass. Temperature was measured by means of a base metal couple and millivolt meter. The junction was placed as closely as possible to the glass rod used for determining the annealing temperature. Upon indication of deformation of the rod the temperature was read and the current shut off.

The annealing treatment described carried the glass above the critical annealing temperature. For this reason the furnace was allowed to cool 50° C. in the first forty minutes and 60° C. in the next two hours. No effort was made to control the rate of cooling below this point but the normal cooling rate of the furnace was low. The annealed glass was examined for stress by observation of the glass between crossed nicols of a microscope.

The following conclusions were reached:

BaO and more particularly ZnO impart brilliance to simple glasses of the type studied. Moreover, they greatly improve durability.

Replacement of Na_2O by either BaO or ZnO increases the softening temperature of a glass. ZnO is considerably more effective than BaO in this respect.

Both BaO and ZnO when substituted for Na_2O increase the modulus of elasticity of a glass. Again, the effect of ZnO is much more pronounced.

The generally accepted factor of 15 for modulus of elasticity for ZnO as given by Winkelmann and Schott is undoubtedly low. A factor of 80 is proposed.

Equal effectiveness of Na_2O and BaO in contribution to elasticity is disputed. Factors of 35 for Na_2O and 55 for BaO in place of 100 for each are more in harmony with results. The values may be somewhat low but proportionately so.

The rate of expansion of the glasses studied increases somewhat even below the critical annealing temperature.

At the critical annealing temperature the rate of expansion increases from two to four times.

Both BaO and ZnO reduce expansion when replacing Na_2O. ZnO is the much more effective.

The expansion factors of English and Turner for Na_2O and BaO are sufficiently correct for most practical purposes. The Winkelmann and Schott factor of 1.8 for ZnO is certainly to be preferred to that of 0.21 of English and Turner.

Determination of the Source and the Prevention of Stones in Glass

Herbert Insley, Bureau of Standards, Washington, D. C.

Stones are segregations of undissolved or crystallized meterials in glass. The petrographic microscope has been found to be the only instrument generally useful in determining what crystalline compounds occur as stones.

Stones may be of three types, devitrification stones, batch stones, and refractory stones. Devitrification stones are the result of crystallization of one or more of the constituents of glass itself. Batch stones are due to incomplete solution in the molten glass of one of the batch ingredients. Refractory stones have their source in the walls of the pot or tank. Devitrification stones were shown by microphotographs. They are caused by improper batch composition, improper temperature in that part of the tank or pot where crystallization takes place or to non uniformity of the melt. The compound $Na_2O.3CaO.6SiO_2$ has been found in several instances in plate and sheet glass. It may occur as large masses in the bottom of the tank or as individual crystals scattered through the finished sheet.

Batch Stones

Undissolved sand is by far the more usual source of batch stones, although lumps of lime and segregations of coloring constituents have also been found. The quartz forming the cores of batch stones may be converted to tridymite or crystobalite or may remain as quartz, depending on the length of time such quartz is in the high temperature zone of the tank.

Refractory Stones

These are derived from the walls of the containing vessels in which the glass is made. These may be the melting tank, flow spouts or the pots or tank from which glass is fed to the machine.

Two general types of stones derived from clay refractories can be recognized. First, those from above the glass surface

and second, those from below the glass surface. Clay walls above the surface of the glass are attacked by the volatilized soda in the furnace atmosphere and by batch dust.

Stones from blocks above the glass line are usually composed only of corundum. Nephelite may be present and sometimes large mullite crystals. Stones from blocks in cooler parts of the tanks, flow spouts and the machine feeding parts, show much less reaction with the molten glass.

Microscopic examination of tank block stones give evidence of their point of origin in the glass making system but give no information as to how such stones may be eliminated.

The Incrustation of Ceramic Wares

By Theo. Lenchner, Roessler & Hasslacher Chemical Company. (Read Before the Art Division).

The process as it exists today consists of three steps—first, the etching process, known as deep plate etching; second, the transferring of the design to the object, and third, the application of precious metal and fixation by firing. The design which is to be etched is drawn on thin tissue paper, whose dimensions and curvature closely conform to the size and shape of the object to be decorated. A highly polished steel plate, about ¼-inch in thickness with a smooth, uniformly hard surface is coated with a preparation consisting for the most part of mixtures of beeswax, black asphaltum and stearin, melted and placed in suspension in heated turpentine.

Such a solution is called the etching resist. After the resist has cooled sufficiently to present a hardened surface, the drawing is placed on the coated steel plate and the design traced thereon through the tissue. The resist is now traced through to the steel surface, or removed with a steel point or an engraver's needle in such a manner that only the lines and elements of design which are to stand out on the finished ware will be exposed to the acid treatment which follows. The underside of the plate is now coated with the resist and then the plate is immersed in a dilute solution of nitric acid until the etching of the exposed design on the plate is of the depth required by the decorator. The plate is now washed and etching resist removed.

TRANSFERRING DESIGN TO OBJECT.

The acid resisting ink is then spread over the design and worked into all details of the etched plate. A typical formula for this ink is a molten and warm mixture of three parts of beeswax, one part asphaltum, one part rosin, one part lamp black suspended in warmed turpentine. The surplus resist ink is then scraped off with a steel knife, and the plate wiped clean, leaving the etching well filled. A special printing paper is used as a transferring medium. This paper is placed carefully over the filled-in design and its reverse side rubbed down freely and evenly with a rubbing brush or printing flannel, until the paper when lifted away from the warm plate, shows the design in resist ink impressed thereon. The resist print is the reverse of the usual printing method. The printing of the resist now forms the protective element, the other portions of the design being left in blank and subject to exposure to acid treatment later on in the process. The print is then placed accurately on the article to be etched, and rubbed down firmly and evenly with a piece of felt. The paper is then moistened thoroughly with dilute alcohol, after which it can be easily removed and the resist ink design will remain on the article.

ETCHING OF THE WARE.

The object, with the exception of the resist ink pattern and the area immediately surrounding the design, is then coated with molten paraffin or wax, by brushing or dipping. This leaves exposed only that portion of the surface which is to be etched, the design proper being protected by the resist ink. Obviously, when the etching is completed the design will stand out in relief.

APPLICATION OF PRECIOUS METAL.

The overlaying or inlaying of the metal, usually gold or silver, is fairly simple if the metal is to be fired on the object. For this purpose, a preparation containing the metals, usually very finely powdered and ground with suitable vehicles and fillers in either paste or liquid form is used. This is painted over the whole of the etched design or filled into the design and fired to temperatures ranging from 900° F. to about 1500° F. After firing, the metal is polished by means of burnishing sand, glass wool or agate tool, thus completing the decoration.

Electrodeposition of metal, especially silver, has been practiced in this country for some time. In this instance, a base containing silver oxide, with proper carrying vehicle, is applied and fired as described above,-after which the ware is placed in an electrolytic solution of silver cyanide with the proper contacts. The metal is allowed to deposit on the silver base, until a sufficient depth of metal is deposited thereon. It is obvious that the design must be continuous so as to avoid too many contact points.

Some of Those at Glass Division Meetings

George W. Morey, Geophysical Laboratory, Washington, D. C.
W. W. Oakley, Corning Glass Works, Corning, N. Y.
Garland Lufkin, Illinois Glass Co., Alton, Ill.
J. F. Greene, Kimble Glass Co., Vineland, N. J.
C. C. Treischel, R. T. Vanderbilt Co., New York.
A. S. Zopfi, Buckeye Clay Pot Co., Toledo, O.
Fred E. Jewett, Ball Brothers Co., Muncie, Ind.
A. E. R. Westman, Rutgers University, New Brunswick, N. J.
D. D. Schurtz, The Sharp-Schurtz Co., Lancaster, O.
C. M. Dennis, American Potash and Chemical Co., New York.
J. D. Magnuson, Denver, Colo.
L. C. Roche, Maryland Glass Corporation, Baltimore, Md.
W. F. Curtis, Fostoria Glass Co., Moundsville, W. Va.
L. R. Milford, Solvay Process Co., Syracuse, N. Y.
Herbert Insley, Bureau of Standards, Washington, D. C.
F. P. Hall, Bureau of Standards, Washington. D. C.
H. G. Fisk, Universal Portland Cement Co., Buffington, Ind.
Hans Nadroetiel, A. C. Spark Plug Co., Flint, Mich.
L. D. Fetterolf, New Jersey Zinc Co., Palmerton, Pa.
G. E. F. Lundell, Bureau of Standards, Washington, D. C.
Jack H. Waggoner, Mellon Institute, Pittsburgh, Pa.
Alexander Silverman, University of Pittsburgh, Pittsburgh, Pa.
Chi Fang Lai, University of Pittsburgh, Pittsburgh, Pa.
Howard R. Lillie, Corning Glass Works, Corning, N. Y.
F. E. Dodge, National Lead Co., Chicago, Ill.
H. H. Blau, Macbeth-Evans Glass Co., Charleroi, Pa.
K. K. Knaell, Macbeth-Evans Glass Co., Charleroi, Pa.
Roy E. Swain, Macbeth-Evans Glass Co., Charleroi, Pa.
F. F. Shetterly, Blue Ridge Glass Corp., Kingsport, Tenn.
W. C. Taylor, Corning Glass Works, Corning, N. Y.
A. T. Hauser, Woods Lloyd Co., Pittsburgh, Pa.
A. Q. Tool, Bureau of Standards, Washington, D. C.
Clarence S. Ross, U. S. Geological Survey, Washington, D. C.
A. J. Monack, University of Illinois, Chicago, Ill.
C. L. Thompson, University of Illinois, Chicago, Ill.
W. F. Dingley, Pacific Coast Borax Co., New York.
C. T. Herssig, National Lime and Stone Co., Findlay, O.
G. S. Fulcher, Corning Glass Works, Corning, N. Y.
Wm. M. Clark, Incandescent Lamp Dept., G. E. Co., Cleveland, O.
C. E. Fulton, Pittsburgh Plate Glass Co., Pittsburgh, Pa.
M. R. Scott, Bausch & Lomb Optical Co., Rochester, N. Y.
Ray F. Caulk, Thompson-Hayward Chemical Co., St. Louis, Mo.
H. K. Richardson, Westinghouse Lamp Co., Bloomfield, N. J.
R. J. Rees, Corning Glass Works, Central Falls, R. I.
G. V. McCauley, Corning Glass Works, Corning, N. Y.
G. M. Walter, Illinois Glass Co., Alton, Ill.
W. G. Begeman, Mississippi Glass Co., St. Louis, Mo.
J. F. Gillender, Gillender Bros., Inc., Port Jervis, N. Y.
Ed. Brockman, Roessler & Hasslacher Chemical Co., New York.
Theo. Lenchner, Roessler & Hasslacher Chemical Co., New York.
C. Nick Muessig, B. F. Drakenfeld & Co., New York.
R. R. Shively, B. F. Drakenfeld & Co., New York.
Donald E. Sharp, Hamburg, N. Y.
W. G. Koupal, Pittsburgh Plate Glass Co., Creighton, Pa.
John Leech, Findlay Clay Pot Co., Washington, Pa.
E. Ward Tillotson, Mellon Institute, Pittsburgh, Pa.
J. C. Hostetter, Corning Glass Works, Corning, N. Y.
H. H. Millar, Electrical Testing Laboratories, New York.
F. C. Flint, Hazel-Atlas Glass Co., Washington, Pa.
Juan Maiza Simavilla, Cristaleria Rigolleau, Buenos Aires, S. A.
George Blumenthal, Ceramic Industry, Chicago, Ill.
S. R. Scholes, Federal Glass Co., Columbus, O.
H. A. Nelson, New Jersey Zinc Co., Palmerton, N. J.
E. L. Hettinger, Willson Products, Inc., Reading, Pa.
J. Earl Frazier, Simplex Engineering Co., Washington, Pa.

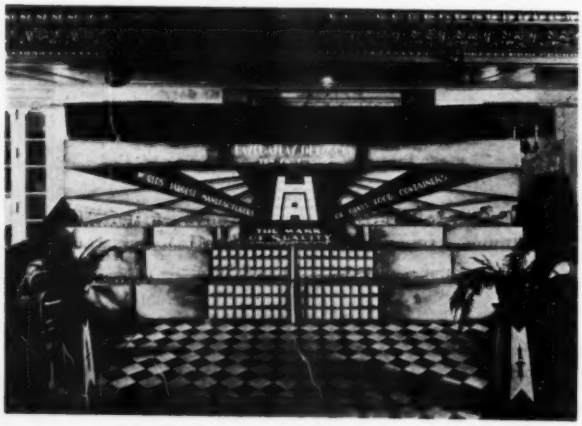
Ceramic Society and Refractories Institute Co-operate

One good outcome of the Chicago meeting was the bringing to a head of plans which had previously been discussed for closer co-operation between the Refractory Section of the American Ceramic Society and the American Refractories Institute.

Plans were approved for bringing the two societies closer together, exchanging membership privileges, combining research activities, centralizing and unifying activities.

A Few of the Exhibits

As already noted, several well-known glass factories displayed their products at the Ceramic Exposition. Two of



THE HAZEL-ATLAS GLASS COMPANY'S DISPLAY AT THE AMERICAN CERAMIC EXPOSITION

the attractive displays of glassware by the Cambridge Glass Company, Cambridge, Ohio, and the Hazel-Atlas Glass Company, Wheeling, W. Va., are illustrated herewith.

The Wilson-Maeulen Company, Inc., of New York displayed their indicating, recording and automatic temperature controlling instruments of all types used in temperature

THE CAMBRIDGE GLASS COMPANY'S DISPLAY AT THE AMERICAN CERAMIC EXPOSITION

regulation in all kinds of ceramic plants. Their potentiometer automatic temperature control for use on glass lehrs and continuous kilns was featured. M. A. Schreiner of the Company's Chicago office, C. E. Hellenberg of the Detroit office, C. A. Rosecrans of the St. Louis office, and C. B. Duff of the New York office were all in attendance.

The Bristol Company, Waterbury, Conn., had a demonstration outfit showing their several instruments adaptable for use in the glass industry.

At the booth of the Erwin Feldspar, Inc., which is affiliated with Golding Sons Company and Consolidated Feldspar Corporation there was a great deal of interest manifested in feldspar products by both the members of the American Ceramic Society and the public in general.

Corhart Refractories Company, Louisville, Ky., Johns-Manville Corporation, New York, Buckeye Clay Pot Company, Toledo, O., and Brown Instrument Company, Philadelphia, also showed examples of their products.

Manufactured Gas Leads All Fuels

The manufactured gas industry, in 1928, led the fuel industries of the country in sales, according to the latest analysis made public by the American Gas Association.

The following table of preliminary estimates prepared and given out by the industries themselves indicates the percentage increase or decrease in fuel sales for 1928 as compared with 1927:

Coke	+2.
Bituminous Coal	—4.8
Anthracite Coal	—5.
Crude Petroleum	+1.
Manufactured Gas	+3.8

The gain in manufactured gas, the Association says, is in the face of a change from manufactured to natural gas.

The Federal Reserve Bank of New York estimated on January 1 that the total volume of all business in the United States in 1928 was about 3 per cent larger than in 1927. The manufactured gas business, therefore, grew slightly more than the general business of the country.

Preparing for the Next Census

Provision for taking the next regular decennial census is made in a bill (H. R. 393) which was ordered favorably reported to the Senate from the Senate Committee on Commerce during the executive meeting of the Committee on December 6. Senator Jones (Rep.), Washington, who announced the action taken by the Committee, also explained that his committee has proposed amendments to the bill. One amendment provides that the census shall be started in 1929 instead of 1930, as provided by the House, and that the census of population and agriculture shall be taken as of November 1, 1929, instead of May 1, 1930.

The other amendment authorizes appropriations to carry on the census enumerations in the following amounts: $24,740,000 for the fiscal year 1930; $8,497,000 for the fiscal year 1931; and $6,256,000 for the fiscal year 1932.—*U. S. Daily.*

University of Michigan Chemical Engineering Course

The University of Michigan, Ann Arbor, Mich., has issued a new announcement of courses in chemical engineering, under Professor Alfred H. White, which contains information relating to chemical engineering, the chemical engineer, the University's facilities for instruction and research, fellowships, admission requirements, outline of instruction given in the four-year program in chemical engineering and the five-year program in chemical and industrial engineering and other data.

Patent Office to Enforce Rules

The work of the Patent Office at Washington in printing the Official Gazette and issuing over 1,200 patents, designs and trade marks each week has become so heavy that the office recently gave notice that rules 165 and 188 will be rigidly enforced. The first rule prohibits the withdrawing of a case from issue after the final fee has been paid and the second is that all assignments must be recorded in the Patent Office not later than the day on which the final fee is paid.

The Manufacture of Laminated Safety Glass

A Review of the United States Patents Relating to the Manufacture of Transparent, Reinforced, Non-scatterable Glass

By Joseph Rossman[1]

Part III

THE "saturation point" with regard to the automobile is less a matter of financial ability on the part of the American public than it is one of safety. City thoroughfares are becoming so crowded that it can be said that traffic congestion is a far greater check to further extension of automobile uses than lack of funds.

The answer to this—in part—is more and better safety devices. The four-wheel brake to the automobile is what the air brake means to a train, in avoiding accidents. And when a mishap does occur, safety glass often keeps it from becoming a tragedy.

(*Continued from the February, 1929, Issue*)

The Use of Chromatic Stabilizing Mixtures

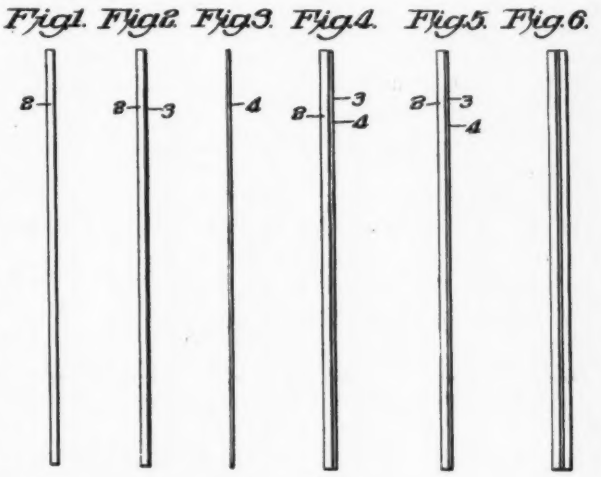
According to U. S. patent No. 1,665,913 each sheet of glass is first prepared by a deposit of gelatin on one surface of each piece of glass. The gelatin is deposited in any convenient manner and preferably a solution of one gram of gelatin to one fluid ounce of water is utilized. One of the sheets of glass is then immersed in a bath of industrial spirit, amyl acetate and tetrachlorethane and while still immersed the celluloid is placed thereon in contact with the gelatin. On the top of the celluloid so positioned the remaining sheet of glass is placed with the gelatin again in contact with the celluloid. The gelatin positioned between the sheets of glass is now immersed in the bath. The three parts are then lightly pressed together and removed from the bath. Sufficient pressure is then applied to cause the gelatin to adhere firmly to the glass. In the manufacture of comparatively small articles manual pressure may in many cases be sufficient to effect satisfactory adhesion, while in the manufacture of bigger articles a press may be utilized having platens lined with soft rubbed, preferably vulcanized.

In practical experience it has been found that a particularly efficacious mixture or solution is made of two parts of tetrachlorethane, three parts of amyl acetate (commercial) and three parts of industrial spirit of good quality.

Formic Acid Solution of Gelatin

According to U. S. patent No. 1,478,862, Dec. 25, 1923, the sheet of glass is thoroughly cleaned, dried and polished, by any ordinary means, and, subsequently, care is taken to prevent dirt from getting on to the surfaces, especially finger-marks or anything of a greasy nature. One surface of the sheet glass is then coated with a glue which is preferably a solution of gelatin and formic acid, 44 grams of gelatin to one quart of formic acid, specific gravity 1.06. This solution is carefully spread over the surface by being sprayed or poured thereon, preferably the latter. After spreading the solution over the whole surface of the sheet of glass it is tilted at an angle of about 75 degrees and the excess solution drained off from one corner until the drops fall at the rate of about one per second. The excess which accumulates at the bottom edge, due to surface tension, is tipped off with absorbent paper, and the sheet of glass is brought back to a horizontal position. It is then put into a suitable drier, and dried in still air for about three hours at 210° to 220° F. or for about fifteen hours at 150° to 160° F. This renders the glue or gelatin "bone" dry, a condition necessary for making a perfect product. The sheet of glass is then removed from the drier and allowed to cool down to room temperature. This cooling may be hastened by placing the glass on a heavy iron plate which quickly conducts the heat therefrom.

The sheet of glass with the dried glue coating thereon is then dipped into a solution of 90% completely denatured alcohol, such as U. S. Government formula No. 1, and 10% water by volume. The formula is: "To every 100 parts by volume of ethyl alcohol of not less than 180° proof there shall be added 10 parts by volume of approved wood alcohol and one-half of one part by volume of approved benzine." The glass is allowed to remain in the solution for a period of about three seconds, whereupon it is removed and drained from one corner until the solution fails to run in a steady stream, but just begins to drop. The sheet of glass is then put upon a clean flat surface, gelatine side up. A sheet of celluloid cut the same size and shape as the glass is dipped in the same solution and drained in the same manner and placed upon the coated glass plate already dipped, care being taken to insure that its edges are in exact registry with the edges of the glass. The alcohol and water solution is maintained at a temperature of 55° to 60° C. by suitable means such as hot water surrounding the tank containing it. This is done to lessen the evaporation from the wet surfaces



CUT 6

Fig. 1 is an edge view of a sheet of glass. Fig. 2 is an edge view of a sheet of glass provided with a glue coating. Fig. 3 is an edge view of a sheet of celluloid. Fig. 4 is a view showing the sheet of celluloid applied to the glue coating. Fig. 5 is an edge view of a two ply product wherein a sheet of glass and the sheet of celluloid are united. Fig. 6 is an edge view of a three ply product wherein two sheets of glass and an interposed sheet of celluloid are united.

[1]Patent Examiner United States Patent Office, Washington, D. C. Chemical Engineer, Member of the District of Columbia Bar.

because a rapid evaporation of alcohol leaves behind an excess of water.

The assemblage of glass and celluloid is now laid upon a piece of linoleum about one-eighth of an inch thick and the same size as the assemblage, and a like piece of linoleum is put upon the top of the assemblage. On top of the upper piece of linoleum is put a series of papers, newspaper quality. The first paper next to the linoleum is much smaller than the assemblage in area and is put upon the central portion thereof. The succeeding papers of the series increasing in area by about one-half inch increments until the entire assemblage is covered. Finally, there is put upon the series of papers a piece of fine cork or relatively softer linoleum the same size as the glass and celluloid, and the assemblage thus completed is placed in a suitable hydraulic press and a pressure of 50 pounds to 250 pounds per square inch is applied to the assemblage therein, the pressure being governed by the size, quality and thickness of the glass. The series of papers as above described are included in the assemblage placed in the press to insure that the first pressure will be applied to the central portion thereof and that the pressure will then be gradually extended to the edge portions thereof to force out the alcohol solution and air bubbles as the pressure increases.

During the application of the pressure, the pressure plates of the press are maintained at a temperature of about 140° F. by water circulating within them, or other suitable means; and the pressure is maintained for a period of about twenty minutes, whereupon the pressure is released, the entire assemblage is removed from the press and the united glass and celluloid composite removed from between the linoleum pads.

Isinglass and Gum as Binder

In U. S. patent No. 1,560,321 dated Nov. 3, 1925, the surfaces of the glass sheets to be united to the celluloid, are first cleaned, preferably with rouge powder and then with chromic oxide suspended in water. The surfaces of the glass sheets may then be washed with running water, left to drain and afterwards dried. The suitably cleansed glasses are treated with a solution of water, deodorized isinglass, British gum, acetic acid and glycerine in or about the following proportions: 30 to 60 fluid ounces of water, 70 to 100 grams of deodorized isinglass, *e.g.*, that known as Swinborne's patent isinglass, 15 to 25 grams of British gum, 4 to 8 c. c. of acetic acid and 2 to 4 c. c. of glycerine. The solution is applied at a temperature of about 130 to 180° F., and is left to dry. When dry, the coating is treated with a bath of formalin (preferably of 40% strength), in which it is left for a few minutes. It is then dried and a very elastic adhesive coating with very hard surface is left. In cases where the process is carried on in a room at a temperature above 60° F., or in cases where small articles are being dealt with, the treatment with formalin may be dispensed with.

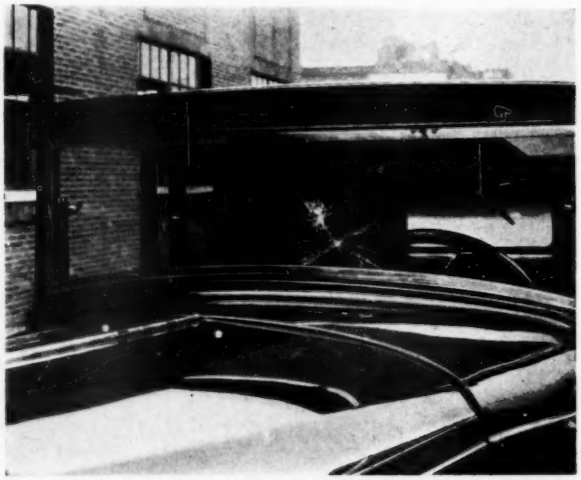
In some cases where the glass is uneven in thickness or where bent or curved glass, such as lenses and curved wind screens, is to be dealt with, a solution similar to the above but without glycerine is applied to the glass surface and left to dry; then a second coat is applied with the glycerine added. Being a stout coating and very elastic, it compensates for excessive expansion and contraction of the glass sheets. Such coating can also be treated with a formalin bath (preferably of 40% strength) for a few moments.

The British gum above referred to is a dextrin artificial gum, which may advantageously consist of starch, water, and glycerine in or about the proportions of 1 ounce avoirdupois starch, 10 fluid ounces of water and 1/15 fluid ounce of pure glycerine. Such gum may be advantageously prepared as follows: The starch is heated in a dry condition to a temperature of about 260° F., then hot water is added and the mixture stirred continually until the starch is dissolved, whereupon the glycerine is added. It has been found that good results are obtained when using starch made from maize fruits or berries.

The celluloid is treated with a bath of spirit varnish preferably consisting of the following ingredients in or about the proportions stated:

1 gallon of methylated spirit (61 overproof), 1 to 2 lbs. of rosin (colophony), 2 to 4 ozs. of shellac (white lac), 1 to 6 ozs. of castor oil.

The celluloid sheet is then placed between the glasses prepared as above mentioned with the treated surfaces in contact, before the spirit varnish is dry, and the whole is placed into a press heated to a temperature of about 120° to 230° F., which should be such as to render the mixture sticky and thus to grip on to the prepared surface of the glass, a light pressure up to 1 atmosphere being also necessary according to the size of the glass. By using a low pressure, the strength of the celluloid in the finished product is greater than when high pressures are employed. The effect of using the mixture is that the rosin is kept by the shellac from becoming too soft at high temperatures, and the shellac is kept by the rosin from becoming too hard at low temperatures. The castor oil also limits the degree of hardness possible. In cases where the reenforced glass is not likely to be subjected to great variations of temperature the use of shellac can be dispensed with. If desired oleic



By Courtesy of Triplex Safety Glass Co. of America

THE PROMINENT NEW YORK ARTIST OWNER WAS KEPT SAFE BY SAFETY GLASS.

acid, rosin oil or other non-drying oil may be used in place of the castor oil.

The edge of the reenforced sheets may be sealed in any suitable known manner but the method preferred is to grind or otherwise form the edge surfaces of the glass sheets inwardly inclined so as to leave a V shaped groove adapted to receive the sealing material which may be British pitch, black prepared beeswax compound, or other sealing material. The inclined edges may with advantage be left rough to facilitate the adhesion of the sealing material.

The Use of Castor Oil

According to U. S. patent No. 1,611,139, Dec. 14, 1926, notwithstanding the seemingly inert qualities of castor oil, when a sheet of celluloid is coated with a film of castor oil, and then pressed firmly against the clean surface of a sheet of glass under considerable pressure, the film of castor oil will apparently be entirely squeezed out and an exceedingly tenacious adhesion will be found to exist between the celluloid and the glass; especially after some heating.

In carrying out this process, the glass will preferably first be coated with a microscopic film of celluloid by applying to the glass a liquid solution of celluloid and allowing it to dry on the glass very thoroughly until all of the residual solvent has evaporated into the air. This takes place thoroughly and expeditiously, inasmuch as the film is exposed at all points directly to the air and there is nothing hindering its drying out thoroughly. The comparatively thick sheet of celluloid which it is desired to "sandwich" between two pieces of glass are then brought against the opposite surfaces of the sheet of celluloid and pressure is applied and maintained at an elevated temperature (such as a steam table) and this condition of temperature and pressure is continued for a few minutes; whereupon it will be found that the parts are most tenaciously secured together and that they cannot be separated by any known means without either breaking or splitting the glass, especially if it be in plates of substantial size.

It has been discovered that castor oil operates so effectively in thus cementing glass and celluloid together that pressures and temperatures within considerable ranges may be resorted to with extremely efficient results, for example, a temperature of from 228° F. to 240° F. under a pressure ranging from 100 pounds per square inch to 400 pounds per square inch will produce a distinctly superior adhesion; the time interval being from say five minutes to twenty minutes. The best results can ordinarily be attained by employing a temperature of 230° F. at a pressure of 150 pounds per square inch for the period of about eight minutes.

In place of celluloid, sheets of cellulose acetate may be employed as the intervening non-shatterable foundation for the plates of glass. This acetate film may be affixed to the glass in precisely the same manner disclosed with respect to the celluloid and the glass may be initially prepared by simply cleansing or by a preliminary varnish of a solution of celluloid. Other elements equivalent to castor oil may be employed. For example, another oil of vegetable origin lacking in solvent properties towards celluloid or cellulose acetate is raw linseed oil and experiments have confirmed that this material may also be employed as above indicated for producing a very efficacious adhesion.

Cellulose Formate as Binding Agent

The process of U. S. patent No. 1,651,581, Dec. 6, 1927, consists in forming a sheet of laminated glass by spraying or otherwise producing a skin of cellulose formate upon one side each of two sheets of glass, then applying to the skins a film of vegetable oil, such as, for example, linseed oil, or its equivalent, forming cellulose formate skins on both sides of the sheet of non-brittle material coating a film of the above mentioned oil on the latter named skins, then interposing the coated sheets of non-brittle material between the sheets of glass, and uniting them.

Shatter-Proof Mirror

The object of the invention of U. S. patent No. 1,653,040, Dec. 20, 1927, is to produce a mirror which will not shatter if subjected to a severe shock.

In Fig. 1, the numerals 6 and 7 designate two sheets of preferably transparent glass, while the numeral 8 designates

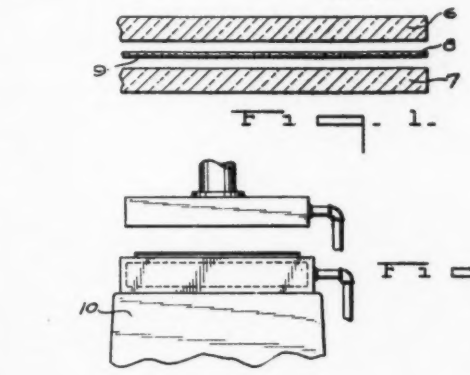


Fig. 1.

Fig. 2.

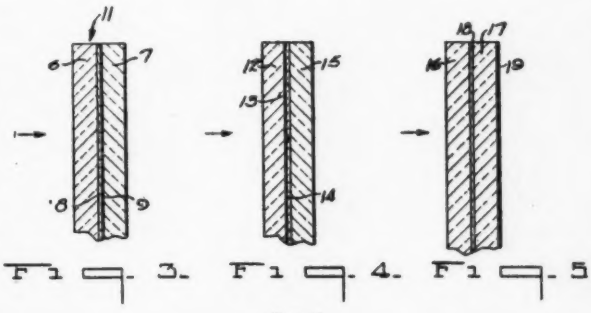


Fig. 3. Fig. 4. Fig. 5

Cut 7

a sheet of non-brittle material such as a cellulose composition material. In the form shown in Fig. 1, the non-brittle sheet of material 8 is provided with a coating 9 of some silvering material such as quicksilver or the like. Ordinarily, in the production of mirrors, the manufacturer makes his own mixture so that quicksilver is mentioned by way of example only, and is not to be taken as a term of limitation. In other words, any material which will produce a suitable reflecting surface is included in the present invention.

After the sheet of non-brittle material 8 has been suitably

coated, as shown in Fig. 1, the laminations are united in accordance with any of the well-known processes of forming laminated glass. Ordinarily, some form of binder is interposed between the laminations to insure a good union when subjected to the action of heat and pressure. The heat and pressure may be applied to the laminations by means of a heated press 10 shown in Fig. 2.

In Fig. 3 is shown the finished sheet as formed in accordance with the illustration in Fig. 1, the arrow indicating the front of the finished mirror 11. In Fig. 4 the front sheet 12 is provided with the coating 13 instead of the non-brittle sheet as in Fig. 1. To produce a mirror as shown in Fig. 4, the sheet 12 is silvered, after which the silvered surface is placed in contact with the non-brittle sheet 14 or a binder between the two, and together with the sheet of glass 15 united. In the mirrors shown in Figs. 3 and 4, the two back sheets, namely, 7 in Fig. 3 and 15 in Fig. 4, need not necessarily be a high grade sheet, as this sheet is not seen and will not cause distortion. In both of the forms shown in Figs. 3 and 4, one of the laminations is treated with a suitable silvering material before the various laminations are united. In Fig. 5 a sheet of laminated glass, comprising two sheets of glass 16 and 17, are united with a sheet of non-brittle material 18 interposed there between. After these three laminations have been combined, the exposed surface of the sheet 17 is given a suitable coating 19. A mirror formed in accordance with the present invention may become broken due to a severe shock, but the glass will not scatter as the non-brittle sheet of material interposed between the glass sheets will retain the fragments of glass even if they are broken.

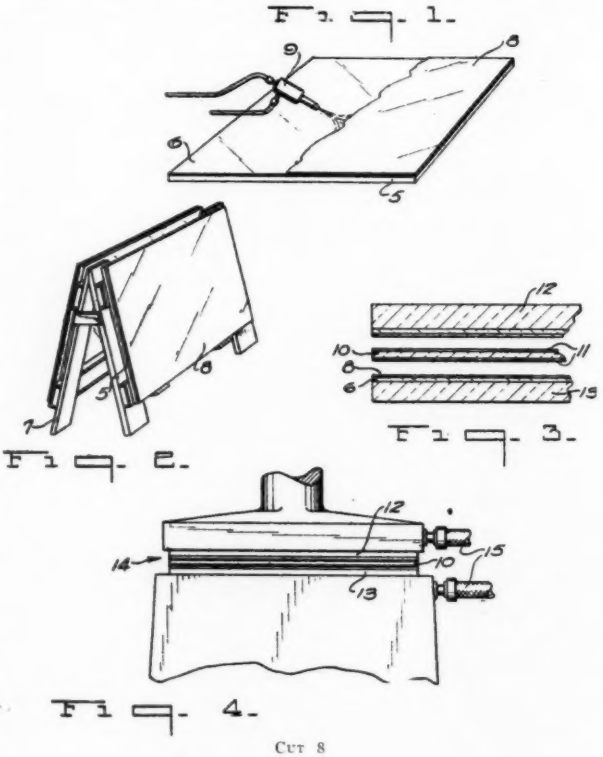
The Use of Canada Balsam

The object of the invention of U. S. patent No. 1,656,691, dated Jan. 17, 1928, is to provide the process for producing laminated glass consisting in spraying a solution of cellulose material on a sheet of glass, permitting the solution to dry to form a skin on the sheet of glass, then spraying or otherwise applying a film or coating of liquid Canada balsam on the skin, then applying a film of liquid Canada balsam to a sheet of non-brittle material such as cellulose composition material, superimposing one sheet upon the other sheet, and then pressing them to squeeze out excess Canada balsam and to cause a union between the sheets.

In the drawings Fig. 1 is a perspective view illustrating the spraying of one of the laminations, Fig. 2 represents a rack for supporting the sheets, Fig. 3 illustrates in section the laminations after they have been treated and before they have been united, and Fig. 4 illustrates the finished product in a press.

In the drawings the numeral 5 designates a sheet of glass which is preferably transparent, the surfaces of which may be ground and polished as desired, although it is not absolutely necessary. A skin of preferably cellulose composition material 6 is formed on the sheet of glass 5. This skin may be applied to the sheet in the form of a liquid spray, the cellulose material being dissolved in a suitable solvent and sprayed on, after which the sheet may be placed in a rack 7 so that the solvents or other liquids may be evaporated off. The rack or other form of supporting means for the sheet during the drying of the skin may be arranged in a suitable compartment, the temperature and humidity of which can be controlled. After the solution has been dried, a skin of transparent material, having an excellent bond with the glass, is carried thereby. After the skin is dried a film of Canada balsam 8 is applied thereto. The Canada balsam may be brushed on, or if it is desired, may be dissolved in some solvent such as xylol and sprayed on by means of a spray 9. The xylol may be permitted to evaporate if it is desired before the sheet of glass is united to a sheet of non-brittle material 10. The sheet of non-brittle material, which may be any of the well-known cellulose composition materials, may be likewise provided with a skin and a film of Canada balsam 11. As shown in Fig. 3, two sheets of glass 12 and 13, respectively, and the non-brittle sheet 10 have been treated and are adapted to be united.

The laminations may be placed in a press 14 illustrated diagrammatically in Fig. 4 of the drawings. The press is preferably constructed so that a pressure will be applied initially centrally of the laminations whereby all excess Canada balsam will be squeezed out from between the



CUT 8

laminations. Conduits 15 may be provided for the purpose of circulating a heating medium through the platens of the press 14.

After the laminations have been subjected to the necessary pressure and temperature, they will, after they have been removed from the press, be permanently united. A sheet formed in accordance with this invention will be capable of standing shocks and will not develop to any considerable extent at least so-called "lets-goes."

The Use of Tetralin

According to U. S. patent No. 1,655,933, dated Jan. 10, 1928, to effect an efficient union or bond between the sheets of glass and the sheet of non-brittle material, one surface each of the two sheets of glass is provided with a skin of cellulose composition material, which is applied by spraying the material in solution upon the sheets of glass. It is desirable to dry the skin before it is united to the non-brittle sheet. The non-brittle sheet may also be treated to form a similar skin thereon. After the skin has been formed on the sheet it is coated with a film of tetralin or tetra-

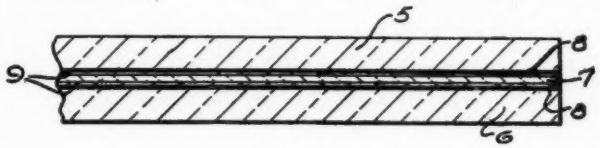


Fig. 1.

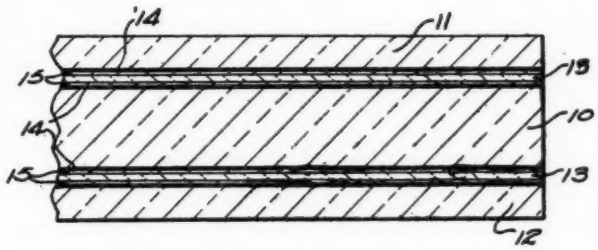


Fig. 2.

CUT 9

Fig. 1 is a fragmentary sectional view illustrating a sheet of laminatel glass formed in accordance with the invention of patent No. 1,655,933.
Fig. 2 is a similar view of a sheet of bullet-proof glass.

hydronaphthalene. Tetralin is a stable water white oily liquid with a boiling point of approximately 400° F., which makes it exceptionally well fitted for this particular use.

After the film of tetralin has been applied to the skin and to the sheet of non-brittle material if desired the laminations are united, preferably under the action of heat and pressure. This union may be accomplished by placing the laminations in a suitable press and pressed together. In this manner all excess tetralin will be squeezed out, and to prevent the trapping of tetralin between the laminations, the press used may be constructed to exert its initial pressure centrally on the sheet.

Splice-Laminating Glass

According to the U. S. patent No. 1,666,252, dated Apr. 17, 1928, it is sometimes desired to laminate sheets of glass larger than any available single sheet of celluloid and to do this it has been the practice, first to cement together, or otherwise join, two or more sheets of celluloid to equal in size the glass to be united. This initial joining of the plurality of sheets has been necessary due to the fact that, unless so joined, during the locating of the laminae in the press and during the application of pressure thereon, one sheet would move relative to the other and thereby leave a slight space between the adjacent edges of the intervening sheets. This lack of continuity of the celluloid would result in a defective and unsightly product which is not acceptable to the trade. It is, of course, essential that this seam be as inconspicuous as possible and that a multiplicity of thickness be avoided, therefore a butt seam is most satisfactory and most desirable.

This invention has for an object to overcome the inherent defects and undesirable features of prior methods of splice-laminating glass and it proposes a new method of, and apparatus for performing that operation without the necessity of initially joining the celluloid sheets.

The method consists in initially forming the adjacent edges of the celluloid sheets so that they will each be an exact counterpart of the other so that when their edges are subsequently brought into butt contact only a faint hair line will be visible at the juncture. These sheets are then inserted between plates of glass (which have been coated with the usual uniting fluid) and their mating edges are brought into a butting relation so as to effect a substantially continuous sheet; only the faintest line being perceptible at their meeting edges. The two sheets are then secured against relative movement and the assembled glass plates and the spliced sheets of celluloid are inserted within the usual power

Fig. 3.

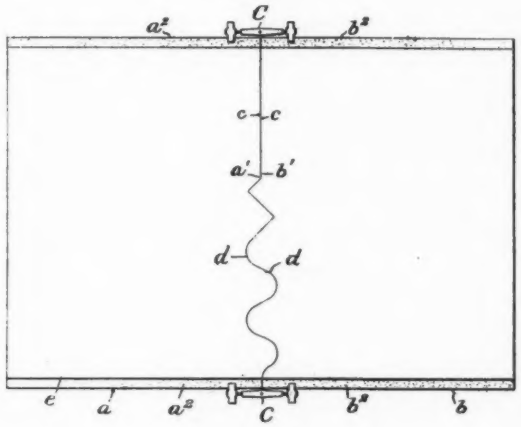
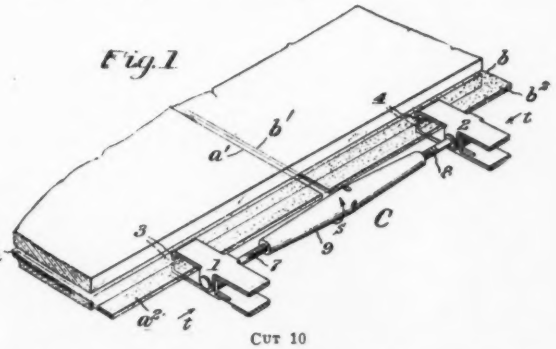


Fig. 2.

Fig. 1.



CUT 10

press which serves to expel the uniting fluid and to effect a permanent union between the glass plates and the intervening spliced sheets of celluloid.

An apparatus adapted to carry out this method is disclosed in the annexed drawings of which Fig. 1 is a view, in perspective, of a device adapted to draw the adjacent edges of the two celluloid sheets into abutting relation and to maintain the sheets against movement during the pressing of the laminae. Fig. 2 is a side view thereof. Fig. 3 is a view in plan of a completely assembled spliced-glass "sandwich" comprising the outer plates of glass and the intervening sheets of celluloid with their counterpart adjacent edges accurately fitted together and held against relative movement by clamps later to be described.

This method consists in forming sheets a and b of celluloid, or other non-brittle substance with counterpart edges a^1 and b^1, respectively. As shown in Fig. 3, these edges may either be straight, as at c, or they may be irregular as shown at d. These sheets are then placed between suitably prepared plates of glass e and f with their adjacent marginal portions projecting beyond the edges of the glass. Suitable clamps C are then secured, at their opposite ends, to the projecting marginal portions of the sheets a and b and, by adjustment of these clamps, the mating edges (if not already in contact) are drawn tightly together so that the juncture appears as but a fine hair line. This completely assembled unit, comprising the outer sheet of glass and the intervening spliced sheet of celluloid, is then subjected to pressure in the usual manner, to effect a complete union of the laminae.

Any suitable clamp may be utilized to draw the sheets a and b forcibly into abutting contact and to hold them in that position after they have been so assembled. The clamp illustrated in the drawings comprises self-closing sheet gripping-members 1 and 2 provided with roughened gripping jaws 3 and 4, respectively, which are forced into contact with the sheets by coil springs 5 and 6. These sheet-gripping members are secured upon right and left threaded pins 7 and 8 threaded into the opposite ends of a turn-buckle 9. It will readily be perceived that after the members 1 and 2 have gripped the sheets a and b, rotation of the turnbuckle in the direction of the arrow t thereby drawing the edges a^1 and b^1 together where they will be held during subsequent handling of the laminae.

Treating with Vegetable Oil

The object of the invention of U. S. patent No. 1,669,044, dated May 8, 1928, is to provide, in the process of producing laminated glass, a sheet of glass having a skin formed thereon and a sheet of non-brittle material such as a cellulose composition material or the like containing a relatively large amount of oil, the process contemplating a treatment of the non-brittle sheet in a manner to produce a film of oil by bringing the oil out from the body of the sheet, the oil being used to assist in creating an efficient bond between the sheet of non-brittle material and the skin on the sheet of glass.

The sheet of non-brittle material used, which may be any of the cellulose composition material family, or the like, is impregnated or formed in such a manner that a relatively large amount of some liquid is contained therein, the liquid

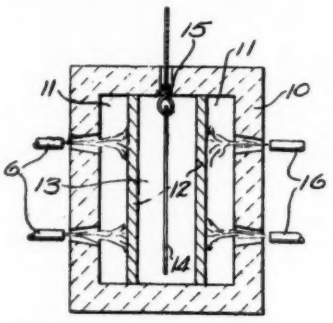


Fig. 1.

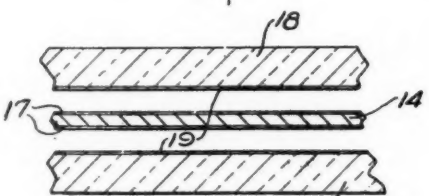


Fig. 2.

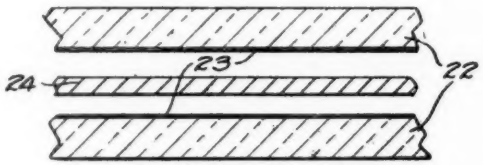


Fig. 3

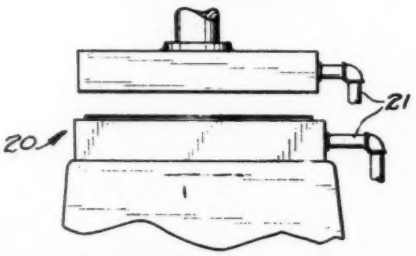


Fig. 4.

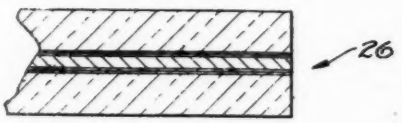


Fig. 5.

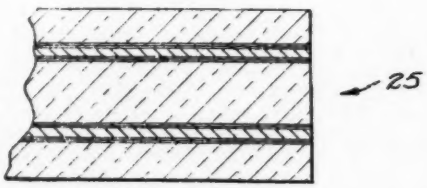


Fig. 6.

being of such a nature that it can be brought to the surface of the sheet in a manner to form a film. The invention contemplates the use of any suitable liquid such as an oil including vegetable oils, such as castor oil. The liquid used may constitute a part of the original batch used in the manufacture of the non-brittle sheet, or the sheet may be formed and then reworked to include the desired liquid.

In the drawings illustrating the patent just referred to the numeral 10 designates a chamber including compartments 11 formed by the walls 12, the walls 12 being arranged in spaced relation, forming a compartment 13 in which a sheet of non-brittle material 14 may be heated. The sheet may be supported and moved by any suitable clip means or the like 15. Heating means 16 may be provided to heat the chamber 11. The sheet of non-brittle material 14 may be preheated in this manner to bring the liquid, or a portion thereof, to the surface forming a film 17, as indicated in Fig. 2. The numeral 18 designates a sheet of glass, preferably transparent, either one or both of whose surfaces may be ground and polished depending upon the use to which the finished product is to be put. In following out the process a suitable transparent skin 19 is formed on the sheet of glass, permitting the solvent or the greater portion thereof to evaporate, thus leaving a comparatively dry skin of material on the sheet. By forming such a skin on the glass, it is believed that a better bond can be had between the non-brittle sheet and the glass sheet. Similar skins may be formed on the non-brittle sheet if desired.

After the skin has been formed on the sheet of glass and the film of oil has been brought to the surface of the non-brittle sheet, the laminations may be superimposed as indicated in Fig. 2, placed in a press designated in its entirety by the numeral 20, and subjected to the action of heat and pressure to cause an intimate adhesion there between. Means 21 may be provided to circulate a heating medium through those portions of the press contacting with the laminations. The press is preferably so constructed that pressure is initially exerted centrally of the laminations so that excess liquid will be expelled from between the laminations. After the laminations have been subjected to sufficient heat and pressure, the sheet may be removed from the press, permitted to cool, and then placed into any desired use. A sheet of glass constructed in this manner will withstand considerable shock, and if in the event the glass sheets become fractured the bond between the sheets and non-brittle sheet will be such that the fragments of glass will remain adhered to the non-brittle sheet.

In Fig. 3 is shown diagrammatically a slightly modified process wherein the sheets of glass 22 are each provided with a skin 23 similar to the manner in which the skin 19 is applied to the sheets 18 in Fig. 2. The numeral 24 designates a sheet of non-brittle material containing a liquid such as a vegetable oil, but which has not been preheated as in Fig. 1 to produce a film on its surfaces. In this particular process, the three laminations are placed in superimposed relation in the press 20 where the heat generated is used to bring the film of oil required to the surfaces of the non-brittle sheet. In either event, sufficient liquid will be present to assist in obtaining a good bond between the laminations.

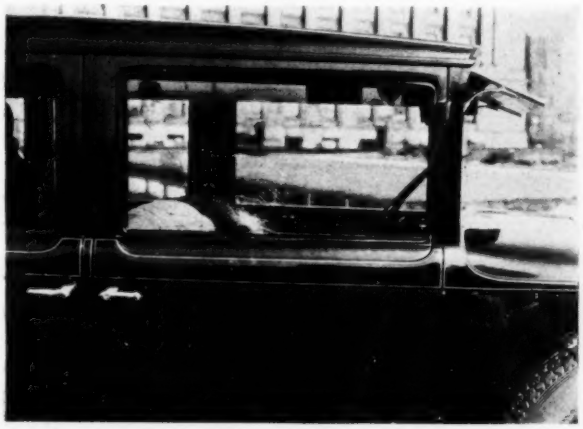
Although the process has been described as relying upon heat and pressure to bring the liquid to the surfaces of the non-brittle sheet, it is to be understood that the invention also includes the application of any substance to the surfaces of the non-brittle sheet to bring a film outwardly from the body of the sheet.

Fig. 5 shows in section the sheet produced by the laminations indicated in Figs. 2 and 3. Of course, it will be understood that the films of oil illustrated are exaggerated, as the amount of liquid remaining in the finished sheet will be relatively very little.

Fig. 6 represents a sheet of so-called bullet proof glass 25 which is formed in exactly the same manner as the thinner sheet 26.

The Use of Animal Oils

The object of the invention U. S. patent No. 1,670,435, is to form a sheet of laminated glass by spraying or otherwise producing a skin of cellulose composition material upon one side of two sheets of glass, then applying to the skins a film of animal oil, then coating both sides of a non-

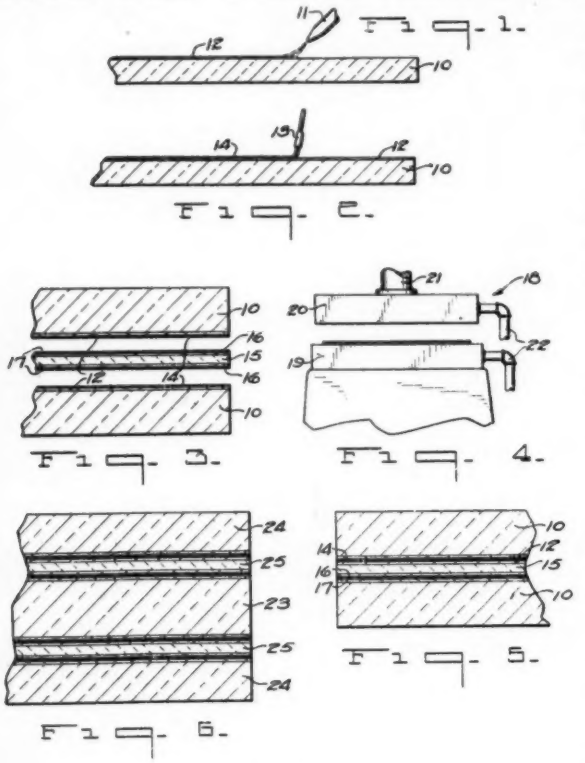


By Courtesy of the Pittsburgh Plate Glass Co.
THE WINDOW OF THIS CADILLAC WOULD HAVE BEEN COMPLETELY SHATTERED WHEN STRUCK BY A BASEBALL, HAD IT NOT BEEN MADE OF LAMINATED GLASS.

By Courtesy of Libbey-Owens Sheet Glass Co.
THIS CAR, OWNED BY A MAN ENGAGED IN MANUFACTURING LAMINATED GLASS, TURNED ALMOST COMPLETELY OVER AND ONLY ONE DOOR LIGHT WAS CRACKED IN THE COLLISION.

brittle sheet of material with a film of animal oil, interposing the non-brittle sheet between the sheets of glass, and uniting them.

In accordance with the present invention, in Fig. 1, the numeral 10 designates a sheet of glass. The sheet of glass has sprayed or otherwise deposited thereon, by means of the spray or the like 11, a coating of preferably cellulose composition material 12, which forms a skin on the sheet



Cut 12

of glass. After the sheet of glass has been coated with a skin, it is preferably permitted to dry so that all of the solvents contained in the solution will evaporate, leaving a substantially dry skin of cellulose material.

The next step in the process is illustrated in Fig. 2, where the sheet of glass 10, having the skin 12, is being coated, by means of a brush or the like, with a film of liquid such as animal oil 14. The animal oil 14 is preferably non-solvent, or substantially non-solvent.

In Fig. 3 is shown a sheet 14 which is preferably a cellulose composition material sheet, and which is substantially non-brittle. The sheet 15 may or may not be sprayed to form a skin 16 on both sides thereof. After the skins 16 have been formed on the sheet 15, they are given a coating of animal oil 17, such as that which is applied in Fig. 2.

Fig. 3 shows the three laminations, namely, the two sheets of glass 10 and the sheet of non-brittle material 15, in position to be united, the three laminations each having the skins thereon and films of non-solvent animal oil.

The laminations may then be placed in a press designated in its entirety by the numeral 18, comprising preferably a lower platen 19 and an upper platen 20, operable by means of the movable plunger 21. Connections 22 may be provided to permit a circulation of steam or other liquid, at preferably a high temperature, through the platens, so that the laminations may be united under the action of heat and pressure. It has been found that the non-solvent animal oil, applied to the laminations as above described, will assist considerably in obtaining an excellent and permanent union between the various laminations. At the same time the animal oil will almost become entirely expelled from between the laminations so that a negligible amount of liquid remains between the laminations in the finished product. The form of press used is such that the pressure is preferably initially applied centrally of the laminations and gradually extending toward the outer extremities so that the animal oil will have an opportunity of becoming expelled.

Fig. 5 designates the finished sheet, and in Fig. 6 is illustrated a sheet of so-called bullet proof glass formed in accordance with the present process, and comprises a central sheet 23, two outer sheets 24, two non-brittle sheets of material 25, and the various skins and coating of animal oil.

As examples of animal oils which may be used, the following are mentioned: Marine animal oils, such as fish oils, liver oils, and blubber oils; oils from terrestrial animals such as neat's-foot.

Mineral Oil

The object of the invention of U. S. patent No. 1,670,436, May 22, 1928, is to form a sheet of laminated glass by spraying or otherwise producing a skin of cellulose composition material upon one side of two sheets of glass, then applying to the skins a film of mineral oil, then coating both sides of a non-brittle sheet of material with a film of mineral oil, interposing the non-brittle sheet between the sheets of glass, and uniting them.

Although there are various grades of mineral oils, petroleum oils that have been relatively highly refined are preferred and possibly where they are suitable for medicinal purposes. Petroleum oils suitable for medicinal purposes are called "petrolatum liquidam," or "liquid petrolatum." Liquid petrolatum is practically colorless so that it is exceptionally useful for the purposes here.

Uniting Wavy Glass

The process of U. S. patent No. 1,692,619, dated Nov. 20, 1928, consists in cutting two sheets of glass having slight wave formations on their surfaces to substantially identical size, arranging an intermediate sheet of cellulose composition which has been properly prepared, between the two sheets of glass. The sheets are placed so that the wave formations of one sheet are substantially parallel to the wave formations of the other sheet, care being taken when cutting the sheets to size that the wave formations extend in the right direction. The sheets are then pressed together to form a composite structure and the outer exposed surfaces of the composite structure are ground and polished.

This completes the survey of the most important patents relating to the production of safety glass. In the following issue, miscellaneous patents relating to a few of the applications of safety glass will be given. The recent machines for making safety glass will also be given.

(*To be continued*)

Colored Glasses

By W. M. Hampton[1]

It is extremely difficult to find a definition which covers all materials which can be classed under the word "glass." If the obvious properties are put down, glasses can usually be found which do not show the required characteristics. Thus transparency is at once suggested by the word, but there are many true glasses which are opaque, at any rate to visible radiation. Hardness and brittleness are usually characteristic of glasses, but very great variations of these properties are found in different types. Resistance to atmospheric attack is a notable feature of many glasses, *e.g.*, church windows, that remain almost unchanged for centuries, but true glasses can be made which easily dissolve in water. The only true criterion by which a substance can be judged is the absence or presence of a crystalline structure. Glasses and liquids do not present any indications of such a structure, and the mechanical, chemical, and optical properties of such are only consistent with the assumption that they are free from any regular grouping of the molecules. Further, crystalline substances show a definite and exact melting point when heated. Vitreous substances, on the other hand, pass gradually from the solid to the liquid state without exhibiting any such phenomena.

Thus glasses may be considered as "congealed liquids," the term "congealed" simply indicating a steady increase in viscosity as the liquid is cooled until at ordinary temperatures it appears as a solid. This question of viscosity is of fundamental importance in the manufacture of glass and particularly of colored glasses, and reference will be made to it later.

It is, of course, this rapid increase in viscosity on cooling which makes the existence of vitreous bodies possible, since the viscosity slows up the speed of crystallization to such an extent that the glass is solid before it can devitrify. Practically all glasses will crystallize if maintained at a suitable temperature for a sufficient time. The facility with which this occurs depends on the properties of the constituents and the proportion in which they are present. In some cases devitrification occurs so rapidly that no practicable cooling rate is sufficient to prevent it, whilst in other cases glass may withstand one method of treatment quite well and yet devitrify under some other method of manufacture. This is one of the factors limiting the range of composition of commercial glasses.

Viscosity is also a deciding factor at higher temperatures, since the temperature at which the glass becomes fluid enough to plain, *i.e.*, to allow the bubbles of gas formed by the decomposition of the batch materials to rise to the surface in a reasonable time, is limited by the rate of corrosion of the fireclay pots in which the melting is carried out. Apart from corrosion, the clay itself softens very rapidly at temperatures above 1400°, and it may be taken that no glass is really a commercial proposition unless it can be manufactured at a temperature lower than 1450°.

[1] Read at a meeting of the Birmingham Section of the Society of Chemical Industry. Reprinted from the *Journal*, July 13, 1928.

The actual chemical behavior, of the glass during manufacture also places limits to the use of certain elements, since either highly acidic glasses or glasses high in alkali very rapidly attack the pot, which not only causes probable failure of the container, but also usually spoils the glass itself, even when actual failure is avoided. The finished glass must also be sufficiently durable to meet conditions under which it is to be used.

The foregoing considerations all have to be borne in mind in connection with the manufacture of colored glasses, since mixtures having a useful transmission for a particular purpose may be quite impossible as manufactured articles.

The manufacture of colored glasses follows very closely the methods adopted in the manufacture of any sort of glass, but in general, colored glasses are required in relatively small quantities of high quality material, and therefore, they are usually manufactured in pot furnaces instead of tanks.

The reactions which occur during fusion are imperfectly understood, but are roughly as follows: The moisture and combined water are first expelled at a temperature of 100-300°, and the alkali nitrates melt at about 320°; it is at this stage that the need for glazing the pot occurs, as this intensely corrosive material probably percolates through the unmelted frit to some extent. At about 500° red lead loses its excess of oxygen, leaving litharge, which itself melts at 880°. Calcium carbonate decomposes at about 825°. The alkali carbonates melt at 800-900°; thus at a temperature below 900° most of the constituents, except silica, are becoming liquid, but the viscosity is still so high that the gases released and the air trapped in the batch cannot escape. Also chemical reactions occur between the constituents, such as between soda and silica, which further complicate the process. Again, the thermal diffusivity of the mixture is so low that a large temperature gradient exists across the pot, with the result that all the possible physical and chemical changes are occurring simultaneously at different points. Thus there is probably finished glass at the wall of the pot and raw batch at the center.

Slowly the whole mixture melts and the more resistant constituents are dissolved, the gases evolved rising to the surface at a rate—in accordance with Stokes' law—dependent on the square of their diameter and the viscosity and density of the glass. The size of the bubbles produced also depends to some extent on the compounds used in the batch and the temperature during the found. Thus a careful selection of raw materials may help considerably in shortening the duration of fusion. Raising the furnace temperature hastens the process in several ways: (1) Decreasing the viscosity of the glass. (2) Increasing the size of the bubbles due to the expansion of the gas. (3) Causing convection currents, helping the dissolution of the constituents. This also has disadvantages which impose a practical limit to the useful temperature independently of the possibility of the furnace, such as: (4) Increasing the rate of corrosion of the pot. This corrosion increases very

rapidly above about 1300°. (5) Decomposing or boiling certain constituents, which thus form fresh bubbles.

The most suitable temperature for founding a given glass is thus a matter of observation and experience, and even these sometimes fail to cure what is known as "seed," or fine bubbles, which refuse to rise to the surface. An expedient employed in this case is the introduction of large bubbles which will sweep the small ones in their path. For this purpose a potato is plunged to the bottom of the pot on an iron rod, causing a sudden and violent efflux of large bubbles. This "boiling up" also helps in mixing the contents of the pot and renders the glass more homogeneous. When the glass is "plain," *i.e.*, free from bubbles, the stoppers are removed and the furnace temperature is lowered until the glass is viscous enough to gather.

Colored glasses are nearly always made by hand, since, as mentioned above, the quantities required of any one type are not usually sufficient to justify the installation of machinery. A gang of men and boys work together in the following way. The gatherer takes a previously heated blowing iron, which is an iron tube about 5 ft. long of suitable size for the work in hand, and dips it in the molten glass, gathering a round blob on the end. This gathering has to be cooled sufficiently to enable it to carry the weight of the next gathering since a total amount of some 40 or 50 lb. has to be gathered in order to provide the size of cylinder required. When the first gathering is cool, the iron is dipped again, and so on until sufficient glass has been collected. When a gathering is large enough, it is "blocked," *i.e.*, rotated in a shaped block in order to remove the bulk of the glass from the rod into a pear-shaped mass on the end. Air is blown into the pipe during this operation in order to bring the glass into a suitable hollow shape of which the sides are of the required thickness, with the base thick enough to be expanded into a cylinder. The blower then heats the end of the squat cylinder in a blowing hole so that the glass becomes plastic. Then by alternate blowing and heating the glass is made into a hollow cylinder of surprising uniformity of thickness of wall. The cylinder is, of course, still closed at the end and somewhat resembles a large cigar. The end is next opened out by bringing a small gathering of glass against it. This softens the glass, which can then be cut with shears. By again heating and rotating, the end can be formed into a continuation of the cylinder. The cylinder is then placed on a stand called a "chevallet" and the blowing iron removed by cracking off. The glass is cut on the inside by a diamond when a tap sends a crack all down the cylinder. This broken cylinder is heated in a flattening lehr and opened out by suitable manipulation, the surface being rubbed by a wooden block, called a "swacker," until the sheet is approximately flat. The sheet then passes down the adjacent annealing lehr and so into the inspection room, where it is sorted and cut up to suit requirements.

So far, the description has applied to pot glasses, but very large quantities of flashed glasses are made since a cheaper article is obtainable by that method of manufacture. A flashed glass, as its name implies, uses a colorless base covered by a thin coating of some intensely colored material. Thus ruby for signal purposes is nearly always flashed, though so far it has not been found possible to provide a suitable flashed green. The only difference in manufacture lies in the gathering. For a flashed glass the first one or two gatherings are made of the colored metal, followed by the requisite number of gatherings of a white glass, the whole gathering then being blown as though it were homogeneous. The result is that the inside of the cylinder is covered with a thin film of colored glass, the thickness being determined by the relative sizes of the two gatherings. It is usual to make the colorless base for this purpose in a tank since manufacture is cheaper under these conditions.

There is such a multitude of possible colored glasses that it is extremely difficult to make any selection that will give an appropriate idea of the various kinds that are made. For instance, we manufacture regularly some 1,200 different tints in the form of rolled plate. Consequently it is only possible to refer to the most characteristic of colored glasses and give some indication as to the materials which produce them.

It is first necessary to refer for a moment to the factors controlling what appears as a colored glass. A glass appears colored because it absorbs a certain definite part of the spectrum. Various methods can be adopted for finding the percentage transmission at any wave-length for any medium. The result of such measurements provides a transmission curve, but such a curve gives very little idea of either the color or the amount of light that the glass will transmit under any given conditions. The human eye is very variable in its sensitivity to different colors. It has a maximum sensitivity in the region of the green, falling away to zero in the red and extreme violet. The light source high-temperature source, such as the sun, provides a spectrum which contains equal amounts of energy at all wave-lengths—at any rate to a first approximation. An oil lamp, however, radiates an enormously greater amount of red light than it does of violet, and it is obvious that the transmission at the red end of the spectrum of any filter is of very much more importance with an oil light than it is with daylight. Thus, in order to obtain an idea of the quantity and quality of the light transmitted by any filter, it is necessary to take into consideration the energy distribution of the light source, the average sensitivity of the human eye, and the transmission curve of the material.

As an indication of the importance of these considerations may be instanced standard rubies and greens for signal purposes. These sub-standards are designed to give 10 and 15 per cent overall light transmission using a standard oil lamp. When the same glasses are used with daylight, however, it is found that the transmission of the green increases to something of the order of 20-25 per cent, whilst the transmission of the red falls to, say, 7-12 per cent.

To simplify the calculation of overall light transmission from the spectro-photometric curve, scales have been devised in which equal horizontal distances represent equal luminosities. If the transmission curve be plotted on such a diagram, the area between the curve and the axis gives directly the overall light transmission. In such calculations, of course, the eye sensitivity curves and the spectral energy distribution curve for different illuminants are known factors: the only variable is, therefore, the transmission curve

of the filter itself. There are several standard methods by which such a curve may be obtained. The one adopted in the laboratory with which the author is associated, is the Hilger-Nutting spectro-photometer.

Colored glasses may be divided into two main classes:—(*a*) those made under oxidizing conditions, (*b*) those made under reducing conditions.

In general, the colors given by various oxides when melted in normal types of glass under oxidizing conditions correspond to those of the salts of the higher oxide. Thus copper under such conditions gives glasses of varying degrees of blueness, the color corresponding fairly closely to that given by solutions of copper sulphate and copper nitrate. Manganese also gives a violet when made on a potash base, which corresponds almost exactly to the color of potassium permanganate. Chromium on a potash base gives colors which approach fairly closely to the color of potassium chromate. But there are certain other colors which cannot be reproduced. For instance, the purple color of chrome alum has not, so far as the author is aware, been reproduced in a silicate mixture by the use of chromium oxide.

It may be said that no two bases give exactly the same color with any coloring oxide, but in general, the differences due to the use of different bases are relatively small, except when the alkali is changed from soda to potash. This change is the most important of all those that can be made under commercial conditions of manufacture. For instance, soda glasses give a brown color with nickel, and this brown color remains reasonably the same whether the rest of the batch consist of a borosilicate, a zinc glass, a lime glass, a lead glass, or a barium glass. When potash is used in all these bases the color becomes violet, and remains so through the whole series. Copper changes relatively little with the change from soda to potash, but the potash glasses are in general slightly bluer than the soda. Chromium gives a reasonably bright yellow on a potash base, but a definite green on a soda base. Manganese changes from a reddish-purple to a blue-violet as the change from soda to potash is made. Cobalt and vanadium are practically independent of the alkali used.

Practically all known elements have been used in glass manufacture, and it is well known that the rare earths form the basis of nearly all eye-preserving spectacle glasses. Thus the essential ingredients of the glasses originally suggested by Sir William Crookes are cerium and a mixture of praseodymium and neodymium. Experimental meltings have even been carried out from materials as uncommon as germanium and erbium.

When a reducing mixture is used instead of an oxidizing mixture, completely different colors are obtained. Thus, a copper glass made under strongly reducing conditions gives the well-known ruby which forms the basis of most of the flashed rubies which are manufactured.

It is interesting to note that railway signal glasses, both red and green, contain the same essential coloring material. Manganese, under reducing conditions, gives a colorless glass which, however, tends to recover its violet tint under the influence of ultra-violet radiation. Gold and selenium also give rubies of varying degrees of purity when made under these conditions.

The essential difference between oxidized and reduced glasses is that the oxidized batches give a colored silicate, whereas the reduced glasses give colors which are due to the scattering of light by ultra-microscopic particles of either the oxide or the element itself. This difference is the cause of most of the glassmaker's troubles in the manufacture of colored glasses. A colored silicate is always the same color provided the correct materials are put in the pot and the glass is properly melted. No after-treatment would affect the color, so once it is done satisfactorily in the pot, troubles as regards color have finished. This, unfortunately, is far from being the case with the colloidal tints. Most of these reduced mixtures are colorless at the high temperature existing during the found, but many of them remain colorless if cooled at a reasonable speed down to room temperature. If such colorless glass be re-heated to the appropriate temperature the color develops very rapidly. The speed with which it develops depends very largely on its previous thermal history. Thus, a selenium ruby, if cooled rapidly from founding temperature to 600° and then held steady at this temperature, will probably be colored very slightly; if, however, the same glass be cooled rapidly to 500° and then re-heated to 550° and held at this temperature, its color will develop very rapidly. It is obvious that control of the color is going to be very difficult with such sensitive material.

Further, there is no maximum color which may be developed and at which a state of completion is reached. These glasses keep on developing their color, *i.e.*, the particles keep on growing in size as long as conditions are suitable. This means, unfortunately, in practice that the glass goes through a series of changes from colorless to ruby and finally on to opal if held long enough. So not only must it be held sufficiently for the color to develop, but it must be stopped in time to prevent opalescence appearing.

These remarks have been applied particularly to selenium ruby, but exactly the same difficulties are found with gold and copper colors. The base also has a very marked effect on the development of the color, and thus changes which would be quite harmless in a colored glass of the silicate type may be found fatal when using a colloidal coloring material. For this reason it is necessary to develop special mixtures for every type of manufacture. A blue copper glass may be put down and the material may be treated in optical fashion, *i.e.*, the whole melting cooled down slowly and the lumps dealt with subsequently; or it may be blown into sheet, pressed into lenses, or rolled into sheets after the fashion of rolled plate. The same mixture is satisfactory for all these purposes. Not so with selenium tints. Every different method of treatment necessitates a different mixture, as the rate of cooling will seriously affect the development of the color.

It is interesting to note the general correspondence between the colors possible with glass and with dyed gelatin. There is no general type of color which can be made under one medium which cannot be approximately copied in the other. For instance, monochromatic violet, blue, and green can be

(*Continued on page* 70)

Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials and Glass Factory Equipment and Operation

Published Monthly

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GLASS INDUSTRY PUBLISHING COMPANY, INC.

50 Church Street, New York

Telephones { Cortlandt 2465 / Cortlandt 2466 — Cable Address, Glasdustry

J. B. KRAK, Technical Editor

Subscription Price .....$2.00 a Year
Single Copy .....20 Cents

THE GLASS INDUSTRY circulates extensively among American and foreign glass manufacturers, their business executives and technical and factory operating staffs.

Vol. 10 MARCH, 1929 No. 3

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The Chicago Meeting of the American Ceramic Society

In its thirty-one years of existence, no other meeting of the American Ceramic Society has excelled this year's gathering at the Stevens Hotel, Chicago, in fostering public recognition of the meaning, value and excellence of American made glass and ceramic wares. Aside from the session in which the members of the Society took part, a program of exhibition and education was instituted, the equal of which has never been seen before.

The industrial ceramic exhibit held in the spacious exhibition rooms of the Stevens Hotel represented the most complete and interesting display of American made products that has ever been assembled. The exhibits were arranged with the object of education rather than selling. The glassware shown had to make its own appeal, and it is certain that it created a deep impression on the visiting public.

The attendance and interest of the general public, which was not only invited but urged to attend was most gratifying. It is sincerely hoped that these industrial exhibits will become a permanent feature of the American Ceramic Society's annual meeting, as it will be a powerful aid in focussing public attention to American made ceramic wares.

There are entirely too many people who are under the impression that foreign made glassware and ceramic products are superior to the home made articles. Exhibitions such as these will aid in dispelling this delusion, which is fostered to some degree by department store buyers who have their own reasons for allowing these impressions to exist.

The program of education did not end with the exhibition. A series of radio programs, which began some time before the opening of the convention, and which were continued until its close, was sponsored by the Convention Committee. These consisted of talks covering ceramic topics, given in a simple and easily understandable way, so that the listener would have no difficulty in following the subject. Special newspaper articles, competitive prize contests and appropriate poster advertising all designed to educate the buying public, were used in a most effective method of propaganda, the details of which are too numerous to allow further elaboration.

The entire schedule of Ceramic Week activities was cleverly arranged, and has been a means of bringing out an understanding of American ceramic wares, of which glassware plays a most important part. Interest was stimulated, a large a throng gathered daily at the exposition, glassware and ceramics have been discussed by people who never before had an interest in the subject. All of this is bound to bear fruit, and increase the sale of American made glassware and kindred products.

The Chicago committee undoubtedly deserves the fullest commendation and the highest praise for what they have accomplished. They have tackled a very difficult task in true Western fashion, with the same energy and hustle that has made the metropolis of Lake Michigan one of the leading cities of the world. The convention was worthy of the

city that received it within its gates. The untiring efforts of the Convention Committee has met with the fullest measure of success, which future conventions will find difficult to equal, and even harder to excel.

Recent Census Shows Trend of Glass Industry

One of the noticeable differences recorded in the 1927 census issued by the Department of Commerce on December 3, 1928 (as announced in the December issue), from that of the 1925 report, is the decrease of 13.2 per cent in the number of glass factories since the 1925 report was compiled. In 1925 there were 310 establishments and the 1927 report shows 269, a reduction of 41 in the number of factories during the two year period.

In 1919, the peak year in this respect, there were 371 factories reported to the Bureau, or 102 more than for 1927.

During this nine year period the country's population, and the production, sale and consumption of glass products had greatly increased, yet by the end of the period over 25 per cent of the factories recorded in 1919 were out of existence.

These figures illuminate a phase of the reconstruction of the industry that for thousands of years until the beginning of the present century was employing glassmaking methods but little better than those used by the earliest known glassmakers, methods based on the blowpipe and the use of human lung power.

So deeply embedded are the old glassmaking ideas in the minds of many old time glassworkers, and also in those of a large percentage of the general public in some glassmaking sections of the country, and so entirely inadequate is their knowledge of the progress of manufacturing methods in this industry, that even within the past year or two it has been possible for schemers to raise large sums of money for glassmaking projects that could not in the opinion of any well-informed glass man, by any stretch of the imagination, be made successful in competition with firms operated along modern lines. It is not surprising then that when mechanical methods of glassmaking were developed, many of the old-time glass manufacturers, some from families with generations of glass blowers behind them and brought up on ancient traditions regarding the craft, failed to perceive the consequences that would follow from the first small advances made in mechanical methods, and neglected to acquaint themselves with and adopt the newer ideas, methods and equipment.

Consequently during the past few years many of them have been wiped out, a process which has been going on gradually as shown by census reports of past years. Mismanagement, failure to provide surplus capital during prosperous times to meet emergencies such as the development of new and revolutionary processes by competitors, sure to develop sooner or later in all industries, and in general a lack of foresight, accounts for the disappearances of many glasshouses since the introduction of modern ideas.

It is obvious that the trend of the industry is in the direction of concentration of production in the fewer and larger plants which are in a position to keep their facilities up to date. Those factories which have kept abreast of this century's revolutionary developments in the glassmaking field are making the most of their opportunities, if the census production figures mean anything.

According to data collected at this year's census of manufactures taken in 1928, the establishments engaged primarily in the manufacture of glass in 1927 reported products valued at $279,708,063, a decrease of 5.5 per cent as compared with $295,959,424 for 1925, the last preceding census year. The total production for 1927 is made up as follows: Plate glass, 120,178,682 square feet, valued at $44,175,695; window glass, 481,021,350 square feet, valued at $26,813,507; obscured glass, including cathedral and skylight glass and opalescent sheet glass, 41,544,699 square feet, valued at $5,092,992; wire glass, 29,115,049 square feet, valued at $4,377,704; pressed and blown glass (except glass containers), $73,893,205; glass containers, $114,380,546; other products, $10,974,414.

Recent developments make it seem probable that future census reports will contain a new classification—laminated safety glass. According to one authority, over twenty million dollars has already been invested in this industry.

By comparing the figures given in the tables below relating to products of all kinds for 1927 with those of 1925, the fluctuations in production and values of all ordinary classes of glassware can be ascertained.

TABLE 1. SUMMARY FOR THE INDUSTRY.

	1927	1925	Per cent of increase(+) or decrease(-)
Number of establishments	269	310	-13.2
Wage earners (average for the year) 1/	65,813	69,371	-5.1
Wages 2/	$81,330,351	$85,735,571	-5.2
Cost of materials, supplies, fuel, and purchased power, total 2/	$109,858,367	$113,652,436	-3.3
Materials and supplies	$79,437,924	(3)	---
Fuel and power	$30,420,443	(3)	---
Value of products 2/	$279,708,063	$295,959,424	-5.5
Value added by manufacture 4/	$169,849,696	$182,306,988	-6.8
Horsepower	306,729	271,639	+12.5

1/ Not including salaried employees.
2/ The amount of manufacturers' profits can not be calculated from the census figures, for the reason that no data are collected in regard to a number of items of expense, such as interest on investment, rent, depreciation, taxes, insurance, and advertising.
3/ Not reported separately.
4/ Value of products less cost of materials, supplies, fuel, and purchased power.

TABLE 2. PRINCIPAL CLASSES, BY QUANTITY AND VALUE.

	1927	1925	Per cent of increase(+) or decrease(-)
Products:			
Total value	$279,708,063	$295,959,424	-5.5
Plate glass:			
Total cast, square feet	157,543,621	165,379,637	-4.7
Rough (sold as such and on hand)---			
Square feet	3,081,028	4,214,888	-26.9
Value	$430,362	$504,110	-14.6
Polished---			
Square feet	117,097,654	117,369,400	-0.2
Value	$43,745,333	$57,207,447	-23.5
Window glass:			
Square feet	481,021,350	567,150,590	-15.2
Value	$26,813,507	$37,524,728	-28.5
Obscured glass, including cathedral and skylight glass, and opalescent sheet glass:			
Square feet	41,544,699	53,951,313	-23.0
Value	$5,092,992	$6,915,578	-26.4
Wire glass:			
Rough (sold as such and on hand)---			
Square feet	25,795,402	28,743,480	-10.3
Value	$2,746,466	$3,546,039	-22.5
Polished---			
Square feet	3,319,647	4,165,486	-20.3
Value	$1,631,238	$2,263,599	-27.9
Pressed and blown glass (except glass containers), value	$73,893,205	$72,085,760	+2.5
Glass containers, value	$114,380,546	$100,301,407	+14.0
All other products, value 1/	$10,974,414	$15,310,756	-28.7

1/ Building glass (other than plate, window, obscured, and wire glass), spectacle glass, and miscellaneous products.

TABLE 3. DETAILED STATISTICS OF PRODUCTS, BY KIND, QUANTITY AND VALUE.

	1927	1925	Per cent of increase or decrease(-)
Total value	$279,708,063	$295,959,424	-5.5
Plate glass:			
Total cast, square feet	157,546,621	165,379,637	-4.7
Rough (sold as such and on hand)---			
Number of establishments	9	14	(1)
Square feet	3,081,028	4,214,888	-26.9
Value	$430,362	$504,110	-14.6
Polished plate made---			
Number of establishments	17	19	(1)
Square feet	117,097,654	117,369,400	-0.2
Value	$43,745,333	$57,207,447	-23.5
Window glass:			
Number of establishments	23	42	(1)
Square feet	481,021,350	567,150,590	-15.2
Value	$26,813,507	$37,524,728	-28.5
Obscured glass, including cathedral and skylight glass, and opalescent sheet glass:			
Number of establishments	20	21	(1)
Square feet	41,544,699	53,951,313	-23.0
Value	$5,092,992	$6,915,578	-26.4
Wire glass:			
Rough (sold as such and on hand)---			
Number of establishments	11	12	(1)
Square feet	25,795,402	28,743,480	-10.3
Value	$2,746,466	$3,546,039	-22.5
Polished---			
Number of establishments	6	6	---
Square feet	3,319,647	4,165,486	-20.3
Value	$1,631,238	$2,263,599	-27.9
Pressed and blown glass(except containers):			
Tableware and ovenware---			
Number of establishments	37	37	---
Value	$12,910,701	$12,230,201	5.6
Pressed tumblers and goblets---			
Number of establishments	22	18	(1)
Dozens	27,280,521	29,678,011	-8.1
Value	$7,773,778	$8,678,725	-10.4
Blown tumblers, stem ware, and bar goods			
Number of establishments	28	32	(1)
Dozens	15,118,776	8,513,932	77.6
Value	$7,931,827	$7,099,863	11.7

	1927	1925	Per cent of increase or decrease(-)
Pressed and blown glass (except containers)—Con.			
Lenses—			
Number of establishments	16	16	(1)
Value	$2,963,535	$2,743,674	8.0
Lamps—			
Number of establishments	9	8	(1)
Value	$458,019	$426,615	7.4
Chimneys—			
Number of establishments	18	18	—
Dozens	2,987,483	3,438,879	-13.1
Value	$2,280,935	$2,657,910	-14.2
Lantern globes—			
Number of establishments	16	13	(1)
Dozens	869,247	1,079,683	-19.5
Value	$634,099	$863,822	-26.6
Bulbs for electric lamps—			
Number of establishments	6	7	(1)
Dozens	(2)	30,109,085	—
Value	(2)	$9,971,371	—
Shades, globes, and other gas and electric goods(except electric bulbs)—			
Number of establishments	27	30	(1)
Dozens	1,806,712	2,431,064	-25.7
Value	$8,153,569	$10,314,792	-21.0
Opal ware, other than containers—			
Number of establishments	17	15	(1)
Dozens	(2)	5,252,850	—
Value	(2)	$4,035,943	—
Cut ware—			
Number of establishments	14	13	(1)
Dozens	151,432	172,780	-12.4
Value	$647,514	$782,513	-17.2
Decorated glassware—			
Number of establishments	17	15	(1)
Dozens	1,340,436	1,754,137	-23.6
Value	$3,235,397	$3,201,674	1.1
Tubing—			
Number of establishments	7	6	(1)
Pounds	21,519,334	16,859,946	27.6
Value	$3,398,424	$3,934,380	-13.6
Specialties, and all other pressed and blown glass products—			
Number of establishments	41	32	(1)
Value	$12,138,958	$5,141,087	136.1
Glass containers:			
Group 1.—Food-product containers—			
Milk bottles—			
Number of establishments	21	27	(1)
Gross	2,130,575	2,036,360	4.5
Value	$11,476,556	$10,588,306	8.4
Narrow-neck blown bottles (packers' ware)—			
Number of establishments	38	(3)	—
Gross	3,300,697	(3)	—
Value	$11,662,367	(3)	—
Wide-mouth blown bottles and jars (packers' ware)—			
Number of establishments	36	(3)	—
Gross	6,296,191	(3)	—
Value	$19,963,289	(3)	—
Pressed ware (packers' ware)—			
Number of establishments	5	(3)	—
Gross	762,708	(3)	—
Value	$2,446,561	(3)	—
Fruit jars (home-pack)—			
Number of establishments	10	14	(1)
Gross	1,515,363	1,288,425	17.6
Value	$11,357,387	$6,640,756	71.0
Group 2.—Beverage containers—			
Pressure ware—			
Number of establishments	35	(3)	—
Gross	3,739,675	(3)	—
Value	$10,395,378	(3)	—
Nonpressure ware—			
Number of establishments	18	(3)	—
Gross	412,892	(3)	—
Value	$1,734,379	(3)	—
Group 3.—Medicinal and toilet preparation containers(both pressed and blown)—			
Number of establishments	52	(3)	—
Gross	12,097,293	(3)	—
Value	$34,759,034	(3)	—
Group 4.—General-purpose containers—			
Number of establishments	27	(3)	—
Dozens	4,822,870	(3)	—
Value	$4,909,455	(3)	—
All other products:			
Value	4/ $27,341,713	5/ $28,683,101	(5)

[1] Per cent not computed where base is less than 100.
[2] Can not be shown separately without disclosing the output of individual establishments. Values included in value of "All other products."
[3] Because of changes in the classification of products, the statistics for 1925 are not strictly comparable with those for 1927. The total value, for 1925, of the products affected by the changes in classification is included in the value of "All other products" for that year. These products were reported as follows:

Kind	Number of Establishments	Quantity (Gross)	Value
Prescriptions, vials, and druggists' ware	43	4,756,661	$15,037,247
Beverage (soda, ginger-ale, grape-juice, mineral, etc.)	44	4,063,780	18,594,646
Packers and preservers (other than home-pack)	34	5,688,154	20,896,538
Battery jars and other electrical goods	10	26,749	902,912
Patent and proprietary	25	5,502,509 (Dozens)	16,930,470
Demijohns and carboys	8	291,618	673,416
All other bottles and jars	35	.....	10,037,116

[4] Includes the value of bulbs for electric lamps and of opal ware, other than containers.
[5] Figures for 1925 not strictly comparable with those of 1927. For this reason the per cent of increase has not been computed. (See footnote 3.)

TABLE 4. MATERIALS CONSUMED IN THE PRODUCTION OF GLASS, BY KIND AND QUANTITY
(Tons, 2,000 lbs.)

	1927	1925	Per cent of increase(+) or decrease(-)
Silica sand	1,758,829	1,753,202	+0.3
Soda ash	604,748	584,721	+3.3
Salt cake	42,507	67,761	-37.1
Lime	127,533	(1)	—
Limestone	230,056	(1)	—
Grinding sand	1,151,267	(1)	—

1/ No data.

TABLE 5. FURNACES USED IN PRODUCTION OF GLASS

	1927	1925	Per cent of increase or decrease(-)
Pot furnaces:			
Number of establishments	75	88	(1)
Number of furnaces—			
Active	213	275	-22.5
Idle	54	55	(1)
Capacity (tons per 24 hours) of active furnaces using—			
Gas as fuel	1,564	2,325	-31.9
Other fuel 2/	189	268	-29.5
Continuous tank furnaces:			
Number of establishments	194	220	-11.8
Number of furnaces—			
Active	411	378	8.7
Idle	75	72	(1)
Capacity (tons per 24 hours) of active furnaces using—			
Gas as fuel	7,966	8,060	-1.2
Other fuel 2/	4,105	2,788	47.2
Intermittent or day tank furnaces:			
Number of establishments	65	73	(1)
Number of furnaces—			
Active	134	115	16.5
Idle	29	34	(1)
Capacity (tons per 24 hours) of active furnaces using—			
Gas as fuel	463	247	87.4
Other fuel 2/	41	262	-84.4

1/ Per cent not computed where base is less than 100.
2/ Oil; coal; coal, oil, and gas in combination.

Colored Glasses

(*Continued from page 67*)

made in either medium. A monochromatic yellow, however, cannot be made in any single filter. The bright yellows that exist transmitting all the orange and red, simply appear yellow because of the lack of violet. Similar filters having a cut at the short wave-length and transmitting all the rays of the visible spectrum are made both in glass and gelatin, and the equivalent hue of the filter varies through orange to red. Nothing, however, exists which only absorbs the red while transmitting all the shorter wave-lengths of the spectrum either in gelatin or glass.

Again, yellow-greens, such as are given by chromium under varying conditions, really have an absorption band in the orange and red and have a rise in the transmission either in the extreme red or in the near infra-red. The same thing applies both to gelatin and to glass. It thus appears that there is some inherent difficulty in making the missing colors, and there is little hope of anticipating that completely new tints can be developed.

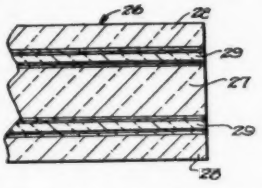
An attempt has been made in this brief survey to give some idea of the manufacturing problems that occur in connection with colored glasses. The firm with which the author is associated has been making colored glasses for nearly a century, and in that period has accumulated an enormous amount of information on the problems connected with this manufacture. Even so, the manufacture is only just emerging from the category of an art into a science, and where so many factors contribute to the final result and success or failure depends on the observance or otherwise of each of these conditions, it is obvious that the skill of the worker will continue to be the predominating factor for a very long time.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

LAMINATED GLASS AND PROCESS OF PRODUCING THE SAME. U. S. 1,701,147. Feb. 5, 1929. John L. Drake, Toledo, O., assignor to The Libbey-Owens Sheet Glass Company. Filed 10/8/26.



An object of the invention is to provide as a new article of manufacture a sheet of laminated glass and a process of producing the same wherein a sheet of non-brittle material is subjected to the action of an oil bath, the oil containing a substance capable of making the non-brittle sheet tacky or sticky, after which said sheet is interposed between two sheets of glass and united thereto, preferably under the action of heat and pressure. Another object is to provide an article and process of producing the same as above set forth, wherein a sheet of glass is coated to form a skin thereon, the skin being united to a sheet of non-brittle material by the aid of camphorated oil interposed therebetween.

A further object is to provide, as a new form of bonding material in the manufacture of laminated glass, an oil or similar liquid containing a substance having a slight solvent action on one of the laminations.

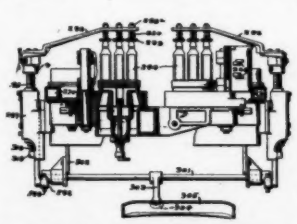
The bath forming the films may be any suitable oil containing a suitable solvent, although the inventor prefers camphor in a vegetable oil. The camphor acts as a solvent for the cellulose sheet placed between two pieces of glass, and the amount of solvent action with the resultant tackiness or stickiness of the sheet, after its treatment in the bath, can be controlled by the percentage of camphor or other solvent in the said bath.

The illustration designates another form of laminated glass which is known in the art as bullet-proof glass. Bullet-proof glass is characterized by its central heavy plate of glass 27, two outer sheets of glass 28, and the two inner sheets of non-brittle material 29. These laminations are joined in accordance with the process above set forth.

To remove excess liquid from between the laminations the pressure applied in the press is preferably initially exerted centrally of the laminations.

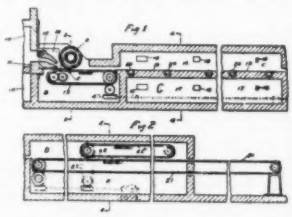
The inventor's claims include: As a new article of manufacture, a sheet of laminated glass, including a sheet of non-brittle material having a film of camphorated oil thereon, which acts as a bonding medium; a sheet of laminated glass including a sheet of non-brittle material and a film of oil containing a relatively small percentage of a solvent for the non-brittle material; a sheet of laminated glass including a sheet of non-brittle material having a film of vegetable oil plus a solvent for the non-brittle material thereon; a sheet of laminated glass including a sheet of glass and a sheet of non-brittle material, and a film of camphorated oil therebetween, the camphorated oil comprising camphor dissolved in a vegetable oil. The process of producing laminated glass consisting in treating a sheet of cellulose composition material in an oil bath containing a solvent, and then uniting the same to a sheet of glass.

GLASS-FORMING MACHINE. U. S. 1,699,566. Jan. 22, 1929. Richard La France, Toledo, O., assignor to The Owens Bottle Company. Filed 4/22/24. An object is to provide mechanism by which discharge of the bottles of each head on machines of the Owens type may be accurately controlled, thereby overcoming the difficulty which has heretofore been experienced of dropping the bottles without having them strike each other. It includes the combination of a rotating mold carriage comprising a plurality of heads or units, a plurality of molds carried by each unit, each mold having a plurality of mold cavities, separate devices individual to the molds for controlling the discharge of articles from the several molds on a unit, each of said controlling devices operable to effect a simultaneous discharge of articles from all the mold cavities of the mold controlled by said device, and adjusting means associated with each said controlling device by which articles concurrently formed in the associated mold are caused to be discharged in succession.



GLASS-WORKING MACHINERY. U. S. 1,701,758. Feb. 12, 1929. Roy D. Mailey, East Orange, and Wilford J. Winninghoff, South Orange, N. J., assignors to Cooper Hewitt Electric Company. Filed 2/5/27. In a glass-working machine, in combination, means for holding a hollow piece of glass, means for holding another piece of hollow glass to be sealed to first said piece, means for rotating said glass pieces at the same rate, means for moving said holding means relatively toward and from each other, said holding means being movable relatively transversely of each other, and means for heating glass pieces carried by said holding means.

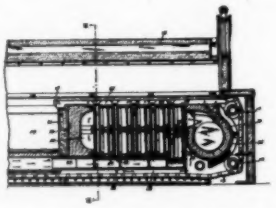
MANUFACTURE OF GLASS. U. S. 1,692,813. Nov. 27, 1928. Edward T. Brown, Detroit, Mich., assignor to Ford Motor Company. Filed 2/16/20. Means for drawing molten glass from the tank, means for sizing the stream of glass so drawn, means for annealing and cooling the sized strip of glass, and arranged successively thereafter the various devices for cutting the strip into pieces and for grinding and finishing both sides of the pieces. It will be understood that there is a direct cooperation between the sheet-forming and the plate glass finishing departments such as to set up the conditions of a unitary condition. The metal is delivered from the tank over a spout on to the upper face of an endless-conveyor with the receiving face travelling continuously in a horizontal plane. The lip of the spout is spaced a distance above the conveyor, and the metal, in passing from the spout, "falls" on to the conveyor—there is no support to the stream content during this time nor is there any shaping or sizing activity during this period. The texture of the sheet is practically completed during the movement of the conveyor face from the point where the stream reaches it to the sizing or dimensioning pass. Because of this the texture formation is actually produced while the metal is in the plane of the pass, and the flow characteristic which may be present is permitted freedom of action so that strains, etc., are prevented.



GLASS-FABRICATING MACHINE. U. S. 1,700,326. Jan. 29, 1929. William J. Miller, Swissvale, Pa., assignor to William J. Miller, Inc. Filed 12/26/22. In a glass machine, a moving mold support, partible blow molds mounted on said support, a take-out device adapted to remove the blown ware from said molds, means for intermittently rotating said support to bring said molds in turn to the take-out position, a rocking lever pivotally mounted intermediate of its ends, means for rocking said lever when a mold assumes the take-out position, and means whereby when said lever is rocked one end of said lever opens the mold in the take-out position and the other end of said lever closes the mold which has passed from the take-out position.

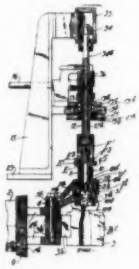
METHOD AND APPARATUS FOR HEATING MOLTEN GLASS. U. S. 1,701,151. Feb. 5, 1929. Arthur E. Fowle, Berkeley, Calif., assignor to The Libbey-Owens Sheet Glass Company. Filed 3/27/26. A sheet glass drawing apparatus, a draw-pot containing molten glass from which a sheet is drawn, a heating chamber surrounding and supporting the draw-pot, and means for heating the chamber by electricity and gas.

GLASSWARE-ANNEALING LEHR. U. S. 1,695,788. Dec. 18, 1928. Percy Q. Williams, Toledo, O., assignor to The Owens Bottle Company. Filed 1/28/27. Ordinarily, in the process of annealing glassware, it has been found difficult or practically impossible to obtain and maintain uniformity of temperature in the heating zone, the tendency having been to produce a high and perhaps normal temperature along the longitudinal center, while the adjacent side areas were relatively cool. An object of the present invention is to provide means for overcoming the above objections by introducing an annealing medium free of products of combustion into the annealing chamber, thus preventing the coating of the ware, and to provide for building a recuperator of units having passageways through which the medium circulates and heated indirectly by products of combustion which are directed between and over the outer surfaces of the units. Uniform temperature conditions are obtained by providing a novel valve slide construction by which transverse sections of the recuperator may be eliminated from the path of circulation of the annealing medium and the relative rate of movement of the annealing medium through transversely spaced points of the recuperator varied.



GLASS-FORMING MACHINE. U. S. 1,689,975. Oct. 30, 1928. Theodore H. Sloan, Charleroi, Pa., assignor to Macbeth-Evans Glass Company Filed 10/12/26. In a glass forming machine, the combination with a source of supply adapted to deliver glass, of a continuously rotating turret provided with a plurality of forming units continuously movable with it, a plurality of glass-receiving cups borne by said turret and normally movable with the turret each in registration with a forming unit, means for holding each of said cups in successsion stationary at the delivery station to receive glass, and means for subsequently causing each cup to move with the turret in registration with a succeeding forming unit. The invention is particularly applicable to paste-mold machines for the manufacture of electric lamp bulbs, lamp chimneys, tumblers, and other paste-mold articles.

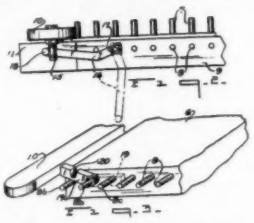
MACHINE FOR MAKING GLASS CONTAINERS. U. S. 1,695,894. Dec. 18, 1928. Warren E. Glaspey, Bridgeton, N. J., assignor to Spring Stopper Company. Filed 12/9/27. Means for rotating the mold carrier step by step to bring each of the molds successively into position at each stage; a mandrel with a threaded tip arranged above each mold; means at one stage to lower the mandrel to move the threaded tip into the neck of the mold; means to cause inversion of the mold in its movement toward a succeeding stage; means for inserting a charge of glass in the mold at a succeeding stage while inverted; means for unscrewing the threaded tip of the mandrel to loosen the same from the glass charge; means for righting the mold in its movement toward a succeeding stage; and means for raising the mandrel from the glass charge in the mold at a succeeding stage.



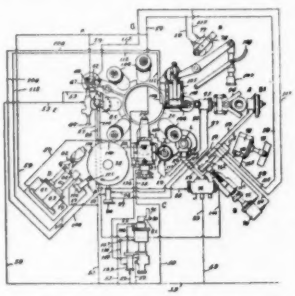
DRAWING SHEET GLASS. U. S. 1,695,547. Dec. 18, 1928. Lawrence A. Grolemund, Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company. Filed 6/18/23. A new form of receptacle or container for the molten glass from which the sheet is drawn, comprising a pair of nested receptacles, both in open communication at one end with the tank furnace from which the supply of molten glass is obtained. The stream of molten glass flowing in from the supply tank is divided, the central portion which ordinarily contains the better conditioned glass flowing into the inner receptacle from which the main body of the sheet is drawn, and the side portions of the flow being diverted into the space between the two receptacles.

APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,700,420. Jan. 29, 1929. George G. Roberts, Ballston, Va., assignor to Virginia Plate Glass Corp. Filed 4/12/26. One object is to so control the temperature at the point of formation of the sheet that the sheet will be prevented from narrowing as it lengthens, as more fully hereinafter set forth. A further object is to provide means whereby the sheet shall be drawn in an inclosed heated chamber and taken down and transferred to the annealing lehr without removing it from the chamber, to thereby prevent fracturing of the sheet by sudden cooling.

GLASS-CUTTING TABLE. U. S. 1,698,506. Jan. 8, 1929. Carl E. Norcross, Charleston, W. Va., assignor to The Libbey-Owens Sheet Glass Company. Filed 9/2/27. An object of the invention is to provide a glass cutting table having a cutter guide associated therewith, and means whereby said cutter guide may be effectively held against displacement during the squaring of the sheet. A further object is to provide a glass cutting table wherein a straight edge acting as a cutter guide is associated therewith, the straight edge being adapted to rest upon the glass sheet during the squaring and cutting thereof, and means being provided for effecting the alignment of the straight edge with the adjacent edge of the table during the squaring of said sheet.

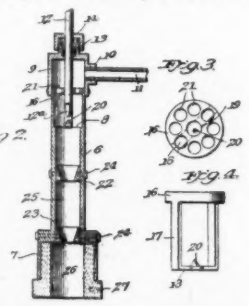


GLASSWORKING MACHINE. U. S. 1,694,867. Dec. 11, 1928. Alexander Samuelson, Terre Haute, Ind., assignor to Chapman J. Root. Filed 7/29/21. An automatic machine for the production of hollow glass ware by the blowing process, the construction being such that the mold carrying table is under the control of a continuously moving motor which, operating to drive a main timing shaft, which serves to mechanically advance the mold carrying table step by step at regular intervals, also operates, through the timing shaft to control certain pneumatic motors by which parts of the apparatus are caused to move through portions of their cycles in synchronism with the mechanical and regular advancement of the mold carrying table.



METHOD AND MEANS FOR TREATING GLASS. U. S. 1,695,538. Dec. 18, 1928. John L. Drake, Toledo, O., assignor to The Libbey-Owens Sheet Glass Company. Filed 9/7/26. One object is to provide in glass sheet drawing apparatus means for reducing a flow of glass passing from a tank furnace or other source of supply into a working chamber or draw pot to a relatively thin film or shallow flow, the apparatus including means for electrically heating the said film.

BURNER FOR GLASS FURNACES. U. S. 1,697,334. Jan. 1, 1929. Paul R. Vitte, Chicago, Ill. Filed 10/22/24. Ordinary oil burners which spray the burning oil directly upon the glass flowing from a melting furnace to the discharge outlet, are found to produce bubbles or "blisters" in the glass body. The object of this invention is to provide a burner in which a mixture of liquid by hydrocarbon and air is employed, and which will produce a flame that will not have any bad effect upon the body of glass and will effectively maintain the same in the desired fluid condition. Fig. 2 is a longitudinal section through the improved burner, detached from the furnace. Figs. 3 and 4 are, respectively, a plan and elevation of a portion of the mixing devices of the improved burner, removed from the burner casing.



Patents Special Use of Glass for Radio Insulators

Patent Is Granted for Combination With Conductor On Revision of Claims

EX PARTE MARSHALL. APPEAL NO. 1271, BOARD OF APPEALS OF THE PATENT OFFICE.

Patent No. 1700066 was issued January 22, 1929, to Albert E. Marshall for Insulators for Radio Frequency Currents, on application No. 726507, filed July 17, 1924.

The examiner's rejection of claims 1 and 2 for glass having a high silica content and low alkali content, used as an insulating material for radio currents, was affirmed on the ground that such device was old in the prior art.

Recommendation was made that the claims be drawn in the form of a combination of an insulator of glass with a conductor arranged to carry radio frequency current in a radio system, as the invention resided in the discovery of the unexpected properties of this glass in connection with high frequency currents.

Dorsey & Cole for applicant.

Insulation Properties Discovered

The full text of the decision of the Board of Appeals (Assistant Commissioner Moore, Examiners-in-Chief Landers and Redrow) follows:

This is an appeal from the final rejection of the following claims:

"1. As an insulating material for radio currents, a glass having a high silica content, a low alkali content, and containing boric oxide.

"2. In insulator for radio currents, consisting of a homogeneous mixture having a high silica content and containing boric oxide, and a small amount of potash."

The references relied upon are: Locke, 1225147, May 8, 1917; Locke, 1226088, May 15, 1917; Locke, 1233486, July 17, 1917; Sullivan et al 1304623, May 27, 1919.

Development of Prior Art

This application is based on the discovery that glass of the type disclosed in the patents to Locke, No. 1225147, and Sullivan et al., No. 1304623, has unexpected and surprising efficiency as insulators for high frequency electric currents, such as employed to generate the carrier waves in radio work, which may have frequencies running into the order of millions per second, in contrast to frequencies of 25 to 60 cycles per second usually employed in high tension power lines.

Several factors are involved in the total result which determines whether a certain material is a good insulator, and these factors have various importance in selecting an insulator for a particular situation.

Physically, insulating materials may be soft or hard, tough or brittle, in varying combinations of degrees. Electrically they may vary in simple ohmic resistance, specific inductive capacity, indicated relatively by their dielectric constant, in their electric strength or resistance to break-down or puncture, in surface conductivity effecting flash over and capacity for holding or absorbing a certain charge.

Important Qualities

It seems clear that specific inductive capacity and absorption may become very important in effect on these high frequency currents. This, in fact, is well recognized, and it is the custom in testing possible insulating materials for radio use, to state the resultant of these several factors in terms of phase angle difference effect on the current which is a convenient comparison of the efficiency of insulators.

It appears from situations in the record that glass in general was classified as relatively poor as an insulating material. for radio apparatus, because of high absorption.

Principles Underlying Radio Communication.—We believe the disclosure of this type of glass and the recognition that it is good for insulators of high potential power lines, as by Locke's patent, is not an anticipation of its use specifically for high frequency currents where it is found that it has an unexpected high efficiency in that relation and where authorities on radio currents discouraged the use of glass in general.

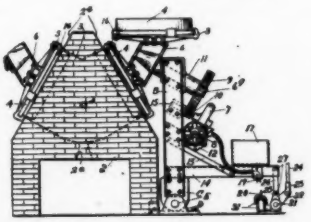
While there is patentable matter in the case, it is considered that the present form of claim does not accurately set forth the invention. It is admitted by appellant that the glass as such is not new, and it is not apparent that appellant is entitled to stop the manufacture of electric insulators of it, since Locke shows ordinary electric insulators made of this glass.

It is only when actually used as an insulator for radio frequency currents that appellant is entitled to claim a monopoly. His only discovery is the unexpected properties of this glass in connection with high frequency currents to lessen the displacement of phase.

Therefore, as we see the problem, the claims should be in the form of a combination of an insulator of this material with a conductor arranged to carry radio frequency current in a radio apparatus or system. Such claim would appear to be clearly warranted by the disclosure and to be commensurate with what appellant has invented.

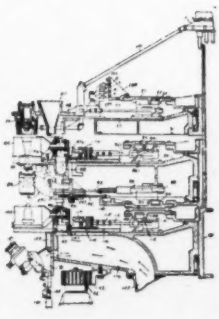
The rejection of the appealed claims is affirmed, but with the recommendation that a claim of the kind above suggested may be entered and allowed if presented in the absence of further references.—From *U. S. Daily*, January 26, 1929.

POT-DRAINING DEVICE FOR GLASS-BLOWING MACHINES. U. S. 1, 698,000. Jan. 8, 1929. Frederick A. Cost, Coffeyville, Kansas. Filed 4/30/24. Novel means whereby pots used in connection with glass blowing machines and in which a residue is left after the glass blowing operation may be easily rotated and swung in and out of position with a kiln or furnace, the heat from which melts the congealed residue glass and causes the same to readily drain from the pots. Two pots may be drained at the same time from a single furnace. Another object is to provide electrically-controlled means embodying a circuit breaker whereby the circuit for actuating the pot revolving mechanism is automatically cut off as said pot is swung to position in the furnace.



PROCESS AND APPARATUS FOR DRAWING GLASS. U. S. 1,701,899. Feb. 12, 1929. Arthur E. Spinasse, Mount Vernon, O. Filed 8/28/26. In apparatus for drawing sheet glass, a slot member for supplying glass to the base of the drawn sheet, the walls of said slot projecting at different depths at different points in the glass bath.

GLASS-FORMING MACHINE. U. S. 1,693,069. Nov. 27, 1928. Albert N. Cramer, Toledo, O., assignor to the Owens Bottle Company. Filed 12/31/25. An object is to provide improved means for mounting the neck mold turn-over group permitting the latter to be quickly removed as a unit from the machine for adjustment, repairs or substitution of another unit. A further feature relates to the mold bottoms and individual controlling devices to control the tilting of the mold bottoms for discharging the finished ware. Improved means for holding the mold sections in closed position during the blowing of the parison therein are provided, also an improved air system for cooling the molds.



The Casting of Corhart Refractories Illustrated

The accompanying photographs depict a general view of the manufacturing plant of the Corhart Refractories Company at Louisville, Ky., together with two interior views showing the big electric furnace in the operation of pouring and a portion of the inspection floor.

During this first year of manufacture on a production basis, Corhart Refractories Company states, it established its product with the glass trade as a definite and valuable contribution toward the advancement of the industry. The company has placed both partial and entire tank installations in half a hundred factories throughout the country, that have proven themselves of such merit on first tests that additional installations in numerous cases have been made.

The principal product of the company is a tank block made by melting the raw materials in an electric furnace and by a process unique in the making of glasshouse refractories, casting the finished shape in a mold. This process results in the physical factors at which tank block manufacturers have been aiming for several years; that is, impenetrability and high resistance to corrosion. These factors heretofore thought unattainable in large size pieces are realized in this one short process. The raw materials used are of the same general nature as those employed in the manufacture of other glass tank refractories. The block is prepared for the glass industry in a form, it is stated, that represents the best physical structure of time-tried materials to resist the destructive action of molten glass under commercial conditions.

MAKING THE CORHART ELECTROCAST TANK BLOCK

Power from the great hydroelectric station at the Falls of the Ohio melts the raw materials in the immense furnace and the blocks are then cast in molds.

GENERAL VIEW OF THE CORHART REFRACTORIES WORKS AND PART OF INSPECTION FLOOR

The span of life of the Corhart Electrocast Tank Block is governed by the composition of the glass and the temperature of the furnace. Years of testing, it is stated, in several plants have proven that under identical conditions, the Corhart block will last enough longer than any other refractory, to cover the higher cost. The important saving results of course from the reduced frequency of shutdowns and the resulting increased tank output.

Of special interest to the window glass plant is the dense crystalline structure of the Corhart block, which, a representative states, positively eliminates block stones, a characteristic, which for the producer of high quality sheet glass becomes the factor of first importance.

The Glass World and What It Is Doing

News of the Industry

Old Chemical Supply House Changes Name

A change has been announced just as this issue goes to press in the name of The Harshaw Fuller Goodwin Company, by W. A. Harshaw, formerly chairman of the board of directors, who states that the company will hereafter be known as The Harshaw Chemical Company and that its office will be at 1610 Hanna Building, Cleveland, O.

In his letter announcing the change Mr. Harshaw relates some of the past history of the company, which first took form when he organized the Cleveland Commercial Company, in March, 1892, to buy and sell chemicals. The following October, Ralph L. Fuller joined the company.

In 1896 Wallace B. Goodwin also joined and in January 1928 it was reorganized as The Harshaw Fuller & Goodwin Company and the manufacture of certain chemicals was begun at Elyria, O., with A. L. Stark in charge of that department. In 1900, Robert S. Wensley became connected with the organization. In 1911, John A. McGean joined and as Mr. Goodwin's health had begun to fail in 1910, forcing him during the next few years to relinquish some of his responsibilities, they were taken over by Mr. McGean and Mr. Harshaw.

In 1916 Mr. Fuller withdrew from the company and there was no further change in the personnel until 1920 when he returned to it. Somewhat later, in 1923 Drake T. Perry became secretary and treasurer.

From 1898 to 1924 Mr. Harshaw was president of the company and during the latter year became chairman of the board of directors. He was succeeded as president by John A. McGean. Meantime Mr. Stark's life had ended and William J. Harshaw had succeeded him in general charge of manufacturing operations. O. J. Hall, William R. Wensley and Ralph L. McGean also became vice-presidents.

In August, 1924, Ralph L. Fuller again withdrew. Since then there have been no changes among the executive officers until very recently.

Throughout the period beginning in 1898, states Mr. Harshaw's letter, the business has been that of manufacturing, importing and jobbing chemicals, oils and dry colors. Inasmuch, however, as the company name—The Harshaw Fuller & Goodwin Company—did not properly identify the concern with the chemical industry, and as additional capital was required to take care of the expanding business, the stockholders at their recent annual meeting decided that the corporate name of the company be changed to The Harshaw Chemical Company, that the outstanding preferred stock, $1,000,000, be allowed to remain as it is, and that the common stock be changed from one having a par value of $100 per share to one without par value. Also an issue of 200,000 shares of the no par stock was authorized, of which 100,000 shares were to be exchanged for the present common stock, and the remaining 100,000 shares to be marketed from time to time as the business may require. Ten thousand shares of the latter are now being placed.

At the organization meeting of the directors on February 12, John A. McGean and his son Ralph L. McGean resigned as directors and officers. W. A. Harshaw was again elected president; R. S. Wensley, vice-president; W. J. Harshaw, vice-president; O. J. Hall, vice-president; W. R. Wensley, vice-president; Drake T. Perry, secretary and treasurer.

The company's factories are located at Cleveland and Elyria, O., and Philadelphia, Pa. The principal office is in Cleveland, with branch offices in New York, Philadelphia and Chicago, and with agencies in most of the larger cities of the country.

Prizes Offered for a Slogan

The National Electrical Manufacturers Association with the National Electric Light Association through Albert Pfaltz, 420 Lexington Avenue, New York, are offering seven prizes totalling $500 for the best slogan devised to promote the use of electric heat in industry. Each contestant may submit not more than three slogans and each slogan must be accompanied by an analysis not exceeding 100 words. Preference will be given to brevity in slogans. The awards will be made on the basis of the best slogan and analysis. First prize will be $250, second $100, third $50, and there will be four of $25 each. There is scarcely an industry in which electric heat is not applicable. One of the best known applications in the glass field is for heating glass annealing furnaces. The committee representing the sponsor of the slogan contest has issued rules for it and pointing out the advantages of using electric heat in industrial plants, as suggesting ideas for the contestants.

Eisler Again Wins Favorable Patent Decision

After several years of extensive litigation, Charles Eisler and the Eisler Engineering Co., Inc., of Newark, N. Y., won another favorable decision on December 28, 1928, from the U. S. District Court at Trenton, N. Y., against the General Electric Company which, alleging patent infringement, originally sued Eisler personally and the company for alleged infringement of a sealing-in operation of a machine essential in glass manufacture.

Judge Bodine ruled that the Eisler sealing-in machine does not infringe the patent held by the General Electric Company relating to similar mechanism and the process thereof. The four suits involving the General Electric and the Eisler interests embraced the following processes and products: 1—Tipless—stem making. 2—Tipless method. 3—Inserting—tipless. 4—Sealing-in—tipless.

Past Year's Exports and Imports of Glass

Export and import figures for the year 1928 are tentatively completed in the table given in the Monthly Summary of United States Foreign Commerce in Glass. The regular feature appearing on the last page of each issue. The total exports of all kinds of glass and glassware in 1928 increased in value from $8,881,972 in 1927 to $10,108,140 in 1928. Window glass exports decreased from $118,082 in value to $102,390 and in quantity from 21,164 boxes to 18,601 boxes. The quantity of unsilvered plate glass exported increased from approximately 1,000,000 square feet in 1927 to 2,279,978 feet, and the value nearly doubled. The value of other window and plate glass exports increased about $6,000 to $439,429. The value of glass containers shipped out of the country increased about $438,000 over 1927. There was a small loss in the value of plain table glass exported. Globes and shades and lighting fixtures showed small losses. There was a decided gain in the exports of electrical glassware other than lighting purposes, the total value for 1928 amounting to $423,883 the quantity being 4,727,289 pounds. The increase in exports of other glassware was $364,000.

There was a decided loss in the total value of glass and glassware imports from that of 1927, amounting to about one and three-quarter million dollars. The most marked reductions were in cylinder, crown, and sheet glass weighing 80 pounds or over per case, which dropped from $1,635,298 in 1927 to $1.341,857 in 1928. Polished plate glass imports dropped from $4,309,713 in value to $3,355,276 while the square feet of plate glass imported during the year was 566,465 less than in 1927. Bottles, vials, jars, demijohns, carboys, molded or pressed and table and kitchen utensils both showed substantial increases. Imports of

glassware, cut and decorated, decreased about $646,000. Bottles, ornaments, gauge glasses and other products not otherwise specified increased about $22,000 in value. 15,740,713 bulbs valued at $175,334 made the total for this item in 1928 about $16,000 over imports in the previous year. Chimneys globes, shades and prism and other illuminating glassware showed a small increase. Other miscellaneous glassware showed a slight decrease.

Depleted Gas Wells Used for Storage Purposes

At the recent Pacific Coast Conference of the American Gas Association, S. W. Meals of Pittsburgh, President of the Carnegie Natural Gas Company and Chairman of the Association's natural gas department, urged gas and oil producers to properly protect their wells when the gas is depleted as such wells are valuable for use in storing manufactured gas. The idea of storing large amount of manufactured gas in discarded natural gas wells originated with Mr. Meals and is based on the experience of the natural gas industry in storing large volumes of gas in the summer time and using it in the winter time. Such practice is now quite widespread through Kentucky, West Virginia, Pennsylvania, New York, Oklahoma and Texas, though the fact has not been generally known to the public. According to Mr. Meals one company has stored more than eight billion cubic feet of gas in some 80 wells covering an area of about 27 square miles.

At Buffalo, N. Y., the use of underground storage has been of great value in meeting the severe winter load. Gas from the Pennsylvania field stored during the summer months in 25 wells located within an area of 800 acres provided a reliable supply. The average depth of these wells is 1,900 feet. The first one was drilled in 1888. The greatest amount stored at any one time was about 300,000,000 feet, but since June, 1916, about 3,000,000 cubic feet have been stored and used as needed. The town of Butler Pa., Mr. Meals stated, has never known a shortage of gas, due largely to one well in which gas is permitted to feed when the line pressure is built up. Speaking of his own company, Mr. Meals stated that a well had been used for storage purposes for 20 years. It is located near Pittsburgh and connected with a 24-inch pipe line to the steel mills.

January Construction Records

Total construction contracts awarded during January in the 37 states east of the Rocky Mountains amounted to $409,967,900, according to F. W. Dodge Corporation. These states include about 91 per cent of the total construction volume of the country. When the above figure was compared with the total for the corresponding month of last year there was a decrease of 4 per cent and when compared with the total for December, 1928, there was a 5 per cent decrease.

Decision Against Hazel-Atlas Reversed

The judgment some time ago awarded to Charles E. Blue by the Ohio County Circuit Court against the Hazel-Atlas Glass Company for royalties covering the use of certain machinery was reversed early in February by the Ohio State Supreme Court.

New Glass Plant for New Jersey

Pittsburgh interests are reported to have purchased a site for a glass plant in New Jersey having both water and rail facilities for transportation.

Trade Activities

The Cameron Glass & Manufacturing Co., Cameron, W. Va., recently resumed operations after a shutdown of several weeks.

The Pennsylvania Bottle Company's plant at Sheffield, Pa., resumed operations in February after a shutdown of several weeks for repairs.

The National Plate Glass Company, Ottawa, Ill., had a warehouse destroyed by fire late in January with damage estimated at about $200,000.

The American Window Glass Company's regular semi-annual dividend of 3½% on the preferred stock has been declared payable March 1 to stock of record of February 16.

The Sinclair Glass Company, Huntington, W. Va., which recently moved after a fire from Van Voorhis, W. Va., to Huntington have put their plant into operation.

The Brown Instrument Company through H. W. Dearing, report that the Company's Buffalo, N. Y., office has been moved to 402 Marine Trust Building. O. B. Wilson has been placed in charge of the Cleveland office, 809 Hippodrome Building.

C. A. Borchert Glass Company, Weston, W. Va., has been incorporated with a capital of $25,000. The incorporators are Andrew Edmiston, Jr., C. A. Borchert, Frank H. Shaffer, and Kenneth S. Kurtz of Weston, and E. W. Hammon, New York.

The Central States Flat Glass Company, Sandusky, O., began the drawing of sheet glass by a modified Fourcault process a few weeks ago, giving employment to a large force of men. Tank fires were lighted about the middle of December and the first drawing operations were reported to be very successful.

The American Glass Works, Paden City, W. Va., has been incorporated to manufacture glass articles. Capitalization: $100,000; incorporators: David Fisher, of New Martinsville; Charles Ray, E. F. Schaffer, C. M. Garnett, Walter Smittle, of Paden City.

Illinois-Pacific Glass Co., San Francisco, Cal., reported unfilled orders on hand for January as fifty per cent ahead of those of January, 1928. The San Francisco plant is operating 24 hours a day, seven days a week. The Company's new Los Angeles plant is just being put into operation.

The Erie Window Glass Company is being incorporated at Erie, Pa., by Frank C. Richardson, one of the founders of the business in 1897 who has taken over the interest of his partner, W. F. Johnson. Mr. Richardson plans to continue the activities of the company along the same lines as heretofore.

The Hazel-Atlas Glass Company at its regular monthly meeting at Wheeling, W. Va., in February declared an extra dividend of 25 cents on each share of stock in addition to the regular quarterly dividend of 50 cents per share, both payable April 1 to stockholders of record at the close of business March 16.

The Flaccus Glass Company's real estate at Tarentum, Pa., and factory equipment, machinery, etc., will be offered at a receiver's sale to be held on the premises at 2 o'clock on March 4. Machinery, raw materials, supplies, etc., are appraised at over $100,000 and there is a large stock of manufactured ware.

Baker Brothers Glass Company, Okmulgee, Okla., were closed down during the month of January making cullet and hot repairs. During this time they installed further improvements in their flattening department and state that the results have been highly gratifying. Their new flat product is now on the market.

T. C. Moorshead, technical director and general manager of the United Glass Bottle Manufacturers, Ltd., London, England, who developed the Moorshead Bottle Machine recently put on the market, has planned a business trip and visits to relatives in this country. He was expected to arrive late in February.

The United States Forest Products Laboratory at Madison, Wis., have announced a short course in woodworking, boxing, crating, etc., following the same general characteristics as previous courses. The course will be of one week's duration and limited to twenty men and the fee for each man enrolled will be one hundred dollars as usual.

The Zihlman Glass Company's plant at Cumberland, Md., which was erected several years as a cooperative concern but had been idle for a long period, has been deeded by the receivers, by order of the court, to Frederick N. Zihlman, representative in Congress of the Sixth Maryland District. Mr. Zihlman was interested in the old plant and himself is an experienced glass blower.

The Belmont Tumbler Company, Bellaire, O., who were recently reported to be installing another large continuous tank, have not done so, but have been making a number of other extensive improvements, including a large oil-burning engine. At the annual meeting held late in January the old board of directors was re-elected as follows: R. C. Faris, J. M. DuBois, Harry Neff, J. W. Stewart, and John H. McGraw.

The Pittsburgh Plate Glass Company's large new unit at their Crystal City, Mo., plant, where thin glass for making laminated safety glass will be made, and which will cost several million dollars, is now under construction. The McClintic-Marshall Company of Pittsburgh have been awarded the contract for the steel work for a two-story 1,000x1,200 feet reinforced concrete building. The company is also making extensive enlargements in its Mt. Vernon, O., sheet glass plant.

The Capstan Glass Company, Connellsville, Pa., report that

all but one of their furnaces were shut down for repairs during December and January, necessitating a temporary layoff of about 400 workers. The No. 2 furnace was put back into operation on January 28 involving the return of about 200 employees. The No. 3 furnace will probably be back in operation about April 1 at which time the remaining 200 employees will return to work and the plant will be running at full capacity.

Work on **The Libbey-Owens Sheet Glass Company's** new four million dollars extension to their present plant at Toledo, O., is under way, the general contract having been awarded to A. Bentley & Sons Co. of that city. The company through the Chicago offices of Lockwood Greene Engineers, Inc., recently awarded contracts for large extensions to its cutting department and heating plant at Charleston, W. Va. H. G. Agsten & Sons of Charleston were awarded the contract for general construction and contracts were also placed for boilers and boiler settings, a fire protection system and heating and boiler piping system.

The Paul Wissmach Glass Co., Inc., Long Island City, N. Y., have been closed down for several weeks remodeling their colored glass plant. One of the outstanding features is a continuous lehr for annealing their flat glass, which is proving very satisfactory. By a very efficient temperature control the glass is annealed perfectly. The chain lehr belt was furnished by the Wickwire Spencer Steel Company. The company manufactures high grade of opalescent, double and single rolled and hammered cathedral, moss, Flemish, Spark-O-Lite types, etc. They also make raised glass letters for Wissmach Raised Glass Company.

The Adamston Flat Glass Company, through W. M. B. Sine, general manager, issued a statement February 13 to the effect that reports being circulated in the trade to the effect that the company would cease making window class and devote its entire efforts to heavy glass are entirely without foundation. Such a move, according to Mr. Sine, has never been contemplated and is furthest from the thoughts of the management at the present time. Improvements and repairs on one furnace which has been down for several weeks have been completed and it is now being heated up and will soon be in operation. Other improvements such as a water system, batch handling and other labor and cost saving equipment have been installed recently.

Recent Deaths

Charles Hoertel

Charles Hoertel, manager of the Ferd. Eckert Company, mirror manufacturers, died at his home in High Point, N. C., on January 26.

Carl L. W. Core

Carl L. W. Core, for a number of years connected with the Pittsburgh Plate Glass Company as superintendent of construction, died suddenly at the age of 51 on Friday, February 1, while in Washington, D. C.

Industrial Publications

Producer Gas Economics, Bulletin No. 91. Wellman-Seaver-Morgan Company, 7000 Central Avenue, Cleveland, O., have issued a new 32-page bulletin containing valuable data on producer gas economics, comparisons of producer gas with other fuels, analyses of coals and a description of the W-S-M. Type L mechanical gas producer with the recently developed Wellman double-bell fuel food. The cover bears a colored sectional view of the Type L producer and numerous illustrations and description of the machine are given. Examples of the results obtained by this equipment in glass factories and other plants are shown. Producer gas is compared with fuel oil and natural gas. A heat balance of hot raw producer gas made in a Wellman-Seaver-Morgan producer is given. Formulas for flow of gases, combustion data, heat combustion of producer gas and other data are given.

Coming Meetings

The American Ceramic Society will hold its annual meeting next year at Toronto, Canada.

The Glass Container Association will hold its annual meeting at Atlantic City, May 1 to 3. The mid-winter meeting usually held in February will not take place this year.

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C.

Germany—36365, Glassware.

France—36370, High grade colored glassware, vases, plates, lamps, etc.

Haiti—36227, Decorative glass for windows.

Glass Stock Quotations

PITTSBURGH STOCK EXCHANGE, FEBRUARY 21, 1929.

	Bid.	Asked.	Last.
American Window Glass Com.	..	..	..
American Window Glass Pfd.	..	..	88
American Window Glass Mch. Com.	..	..	25
American Window Glass Mch. Pfd. Cum	..	..	47
Fittsburgh Plate Glass	..	..	69½
Standard Plate Glass Com.	..	..	4¾
Standard Plate Glass Pfd. Cum.	..	..	15
Standard Plate Glass Prior Pfd.	..	..	30
United States Glass	..	..	12

TOLEDO, O., FEBRUARY 20, 1929.

	Bid.	Asked.	Last.
Owens Bottle Pfd.	..	..	..
Libbey-Owens Sheet Glass Com.	..	..	..
xLibbey-Owens Pfd.	115	..	116½

WHEELING STOCK EXCHANGE, FEBRUARY 21, 1929.

	Bid.	Asked.	Last.
Hazel-Atlas	106½	107	107½
Imperial	..	..	72
Fostoria	190	..	185
Central	..	75	..
Jefferson Pfd.	..	..	96

READERS' WANTS AND OFFERS

FOURCAULT WINDOW GLASS PLANT FOR SALE

Equipped with 8 Fourcault Process sheet drawing machines, latest type of batch storage and handling facilities. Designed and constructed by the Simplex Engineering Company. Furnaces exact duplicates of ones in successful operation in the plant of the Blackford Window Glass Company at Vincennes, Indiana. Ample natural gas available for several years at average price of 25c per 1000 cu. ft.

Plant was operated for only a few months. Is in excellent condition and can be made ready for operation at small cost. Close proximity of other Fourcault Process plants makes plenty of experienced labor available. Can be bought cheap and on reasonable terms. Address Carl L. Hornor, Clarksburg, W. Va.

The Sharp-Schurtz Company

CHEMISTS AND CONSULTING ENGINEERS

For the Glass Industry

LANCASTER, OHIO U. S. A.

Current Prices of Glass-Making Materials

February 20, 1929

Quotations furnished by various producers, manufacturers and dealers.

Acid		Carlots	Less Carlots
Citric (dom.)	lb.	.46	.46
Hydrochloric (HCl) 20° tanks, per 100 lb.		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	5.75
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.38½
Alcohol, denatured	gal.	..	.52
Aluminum hydrate (Al $(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.21-.22
Ammonia water (NH_4OH) 26° drums	lb.	.03	.03¼
Antimony, metallic (Sb)	lb.	..	.09⅝
Antimony oxide (Sb_2O_3)	lb.	..	.12-.14
Antimony sulphide (Sb_2S_3)	lb.	..	.14
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.05
Barium carbonate ($BaCO_3$)			
Precipitated	ton	57.50-59.50	60.00-61.50
Natural, powdered, imported	ton	45.00	50.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.04¾-.05½
Barium nitrate ($Ba(NO_3)_2$)	lb.	.08¼	.08½
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	28.00-35.00	..
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	..	16.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.02½-.02¾	.02¾-.03¾
Boric acid (H_3BO_3)	lb.	.05½-.05¾	.06-.07
Refined	lb.	.05½-.05¾	.06-.07
Cadmium sulphide (CdS)—			
Red	lb.	..	1.20
Orange	lb.	..	1.00-1.25
Yellow	lb.	..	1.20-1.40
Chromium oxide (Cr_2O_3)	lb.	.24	.25
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25-.30
Black prepared	lb.	.	.30
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Artificial or Chemical	lb		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
Feldspar—			
100 mesh	ton	11.00-20.00	15.50-22.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Formaldehyde	lb.	..	.09½
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.03¼-.03½
Black (FeO)	lb.	.03½	..
Kaolin (f.o.b. mine)	ton	9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)			
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.0935-10.00	.10¼
Litharge (PbO)	lb.	.0835-.08¾	.09¼
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	11.50-12.50	..
Burnt (CaO) ground, in bulk	ton	8.00	..
Burnt, ground, in paper sacks	ton	10.00-11.00	..
Burnt, ground, in 280 lb. bbls.. Per bbl.		2.15-2.25	2.30-2.60
Limestone ($CaCO_3$)		2.00-2.50	..
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07
Manganese 85% (MnO_2)	lb.	.04	.04½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¾
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.23-.32
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.08
Potassium nitrate (KNO_3) (gran.)	lb.	.	.05⅞-.06
Potassium permanganate ($KMnO_4$)	lb.	.16	.16½
Powdered blue	lb.	..	.24-.26
Rochelle salts, bbls.	lb.	..	.23
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.90-2.00
Silver nitrate ($AgNO_3$) (100 oz.) per oz.		..	.39⅞
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.22½	..
In barrels	Per 100 lb.	1.55-1.57½	2.40
In bags	Per 100 lb.	1.37½-1.40	..
Spot orders.. .025 per 100 lbs. higher			
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.90	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent	Per 100 lb.	2.25½	2.50
Sodium selenite (Na_2SeO_3)	lb.	..	2.35
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.45	3.80-4.00
Flowers, in bags	Per 100 lb.	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb.	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.39	.37½
Tin oxide (SnO_2) in bbls.	lb.	..	.54
Uranium oxide (UO_3) (black, 96% U_3O_8) 100 lb. lots	lb.	..	1.50-2.25
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to January 24, 1929

	December 1927 Quantity	December 1927 Value	December 1928 Quantity	December 1928 Value	Twelve Months Ending December 1927 Quantity	Twelve Months Ending December 1927 Value	Twelve Months Ending December 1928 Quantity	Twelve Months Ending December 1928 Value
Glass and glass products (total)	.....	$740,444	.....	$880,612	.....	$8,881,972	.....	$10,108,140
Plate and window glass—								
Window glass, common, box 50 sq .ft.	681	$5,400	3,575	$13,484	21,164	$118,082	18,601	$102,390
Plate glass, unsilvered, sq. ft.	98,696	39,732	214,635	61,081	1,081,339	347,164	2,279,978	680,726
Other window and plate glass lbs.	595,059	36,876	377,988	43,928	4,415,321	433,625	3,904,830	439,429
Glass containers (bottles, vials and jars)	.....	253,681	.....	261,720	.....	3,076,890	.....	3,514,936
Table glassware, plain	.....	120,398	.....	120,801	.....	1,440,274	.....	1,381,617
Table and other glassware, cut or engraved	.....	13,466	.....	7,342	.....	142,731	.....	135,411
Lamp chimneys and lantern globes lbs.	148,945	28,354	123,630	25,349	1,911,491	388,250	1,600,626	326,746
Globes and shades for lighting fixtures lbs.	140,784	49,802	175,283	60,649	1,668,690	610,738	1,813,637	644,954
Chemical glassware lbs.	17,451	16,841	22,569	20,564	212,972	194,192	235,647	200,820
Electrical glassware, except for lighting lbs.	121,506	14,702	380,405	45,728	2,240,263	236,824	4,727,289	423,883
Other glassware	.....	161,192	.....	219,966	.....	1,893,202	.....	2,257,228

IMPORTS

Corrected to January 24, 1929

Glass and glass products	.....	$1,369,931	.....	$1,131,737	.....	$17,033,027	.....	$15,312,751
Cylinder, crown and sheet—								
Unpolished, not bent, obscured, beveled, etc.—								
Weighing less than 80 pounds per case dut. lb.	3,723,896	$116,935	3,588,524	$112,683	45,984,107	$1,226,473	37,178,043	$1,163,079
Weighing 80 pounds or over per case dut. lb.	1,988,878	121,426	2,450,894	101,704	36,763,403	1,635,298	30,413,337	1,341,857
Polished and bent, obscured, beveled, colored, etc., unpolished and polished, and all silvered dut.	.....	38,561	.....	41,770	.....	392,444	.....	560,724
Plate glass—								
Polished, unsilvered dut. sq. ft.	1,037,580	271,558	1,106,605	209,983	15,409,085	4,309,713	15,842,620	3,355,276
Other dut. sq. ft.	128,941	40,162	125,184	24,879	1,377,395	332,060	1,727,173	451,443
Bottles, vials, jars, demijohns and carboys, molded or pressed dut.	.....	17,533	.....	22,502	.....	192,699	.....	247,663
Table and kitchen utensils dut.	.....	26,384	.....	34,069	.....	200,078	.....	298,098
Glassware, cut or decorated dut.	.....	290,124	.....	244,829	.....	3,750,568	.....	2,904,932
Blown glassware, n. e. s.—								
Bottles, ornaments, gauge glasses and other n. e. s. dut.	.....	168,431	.....	75,893	.....	1,863,442	.....	1,885,100
Bulbs for electric lamps dut. No.	1,470,400	15,251	1,785,574	20,548	15,126,726	158,814	15,740,713	175,334
Chimneys, globes, shades, prisms and other illuminating glassware dut.	.....	76,182	.....	97,365	.....	968,046	.....	987,899
Articles and utensils for chemical, scientific, and experimental purposes dut.	.....	58,463	.....	49,331	.....	537,122	.....	548,339
Other glassware dut.	.....	128,921	.....	96,181	.....	1,466,270	.....	1,393,007